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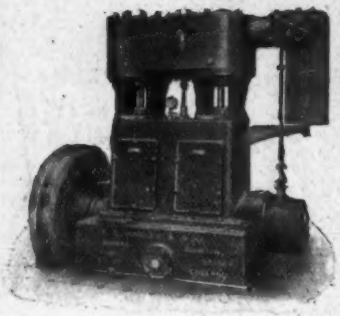

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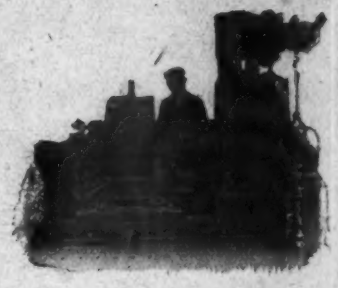

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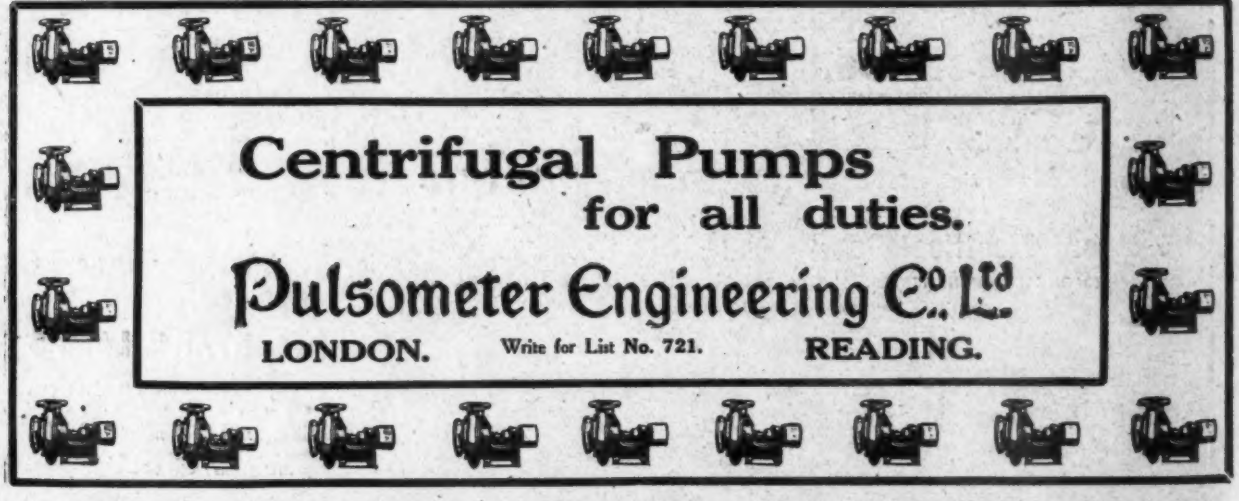

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THE

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VOL. LXXXI. OCTOBER 5, 1917. No. 2,080.

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THE ASSOCIATION MOVEMENT.

A FORTNIGHT ago we briefly recorded the gist of an important speech made by Mr. L. A. Paish, on behalf of the Government, to the members of the Birmingham Brassmasters' Association.

It will be recalled that Mr. Paish then announced the Government's desire to support and assist in the formation of Trade Associations to the end that British manufacturers may be more efficiently organised and equipped to combat overseas competition after the war.

This Government advocacy of the association movement is welcome evidence of the new spirit which permeates the revitalised Commercial Intelligence Branch of the Board of Trade, whose efforts on behalf of British trade deserve all possible encouragement.

The justification of, and the necessity for, the existence of trade associations has been amply demonstrated on many occasions, but never so conclusively as in the present period of national stress.

The Government in particular has appreciated the advantage of being able to get into close contact with an entire trade through the medium of a well-regulated association representative of that trade, and the individual firms engaged in trade have learned that their policy and needs can be more effectively voiced by such a body than by their unorganised individual representations.

A prominent instance of such mutual recognition was provided by the Government's recent employment of the organisation of the Cable Makers' Association as the controlling authority for the distribution of the restricted supplies of copper amongst all British cable-makers—whether members of the Association or otherwise—for the purpose of facilitating the manufacture of insulated wires and cables required for repairs and maintenance.

It is well known that these functions were faithfully performed, and that the Government, the producer, and the cosumer, all derived substantial benefits from the assistance thus afforded them by an Association which, according to its early critics, could not be expected to help anyone outside its own roll of members.

The C.M.A. is thus doing work of national importance, and, as is usual when an individual or an institution achieves distinction, we are encouraged to examine its origin and policy in the hope that the path of those who follow may be illumined by the light of the experience of those ahead.

Such a review becomes an urgent duty when we realise the increased attention now being devoted to the "association movement" and industrial organisation generally.

Parenthetically, it may be hoped that the time is not far distant when each and every trade in the country will have its own trade association, competent and empowered to voice its opinions on the council of a Federation of such associations, to whom the Government could safely turn for guidance on all matters pertaining to industrial legislation.

It is probable that the comparatively backward state of the association movement in this country is to some extent due to the trait which, in an Englishman, is euphemistically described as "a sturdy spirit of independence." Although invaluable in pioneering and colonisation, this spirit becomes almost a handicap in a highly organised community in that it is liable to prevent the British manufacturer from co-operating with others engaged in his trade, even after such co-operation has been shown to be essential to his own welfare.

Reverting to the origin of the C.M.A., we find it was founded about 20 years ago, at a time when the public generally had no experience to guide them when buying electrical equipment, and when, accordingly, the *price* was the chief, and often the only, consideration.

Any cable-maker desirous of improving the quality of his goods was further hampered by the circumstance that in many cases his superior, and consequently more expensive goods, differed *in appearance* very slightly from those of his less scrupulous competitor, whose object was to make immediate profits rather than an enduring reputation.

The inevitable result was that the manufacturers were brought to the verge of ruin by their cut-throat competition, and the consumers slowly came to realise that the policy of accepting the lowest price was not always an unmixed blessing.

A few of the manufacturers therefore came together and formed the nucleus of the C.M.A. on the basis of their common agreement that it was vital in the interests of the entire electrical industry that their cables should conform to at least a minimum standard of quality, and the well-known "Association grades" were accordingly established.

Having set up these agreed standards of quality, the adoption of standard prices was an obvious and necessary sequel, and the public accordingly has for years been able to rely upon buying goods from any member of the C.M.A. at the same price, and of at least the same minimum and sufficient standard of quality.

As each member was at liberty to devote his profits to the betterment of his goods, there naturally arose a very keen competition in *quality*, which has been advantageous to the maker and user alike, whereas the former unrestrained competition in *price* was disastrous to both.

To-day, thanks to the initiative of the founders of the C.M.A., the goodwill of the expression "Association grade" is of an international character, and stands so high that the best recommendation those interested in the sale of non-C.M.A. cables can think of in appraising their goods is to claim that they are "equal to Association quality."

From the above, it will be seen that one of the principal ideals of each new trade association, as and when it is formed, should be the maintenance of the *quality* of their goods, or, as expressed by the late Prime Minister (Mr. Asquith), when speaking on the Paris Economic Conference in the House of Commons on August 2nd, 1916, "the development of trade associations for common action at home and abroad *to raise the average standard of production*."

A New Electric Vehicle Maintenance Scheme.

In the opinion of the Commonwealth Edison Co., of Chicago, the psychological moment has arrived to render particularly easy and attractive the pathway of the intending purchaser and user of electrical motor vehicles. Accordingly, the company in question has just issued details of a scheme which it has had under development for the past 18 months, whereby owners of such vehicles can secure complete maintenance of their machines, including garaging, charging of batteries, renewal of all wearing parts, periodical body painting, and the like, for a stipulated contract term at a flat rate based on an estimated daily service.

The scheme, which includes the erection of an electric vehicle garage with a capacity of about 100 machines, has been developed by Mr. Wm. P. Kennedy, a New York consulting engineer, who has had many years' experience of the electric vehicle problem, involving a complete examination of haulage methods and requirements, including the operating costs of many firms now using electromobiles. Following the example of the majority of electric light and power supply undertakings, the Commonwealth Co. does not intend to undertake the direct sale of the machines, although it is prepared to facilitate the arrangement of payments if clients so desire. Customers may select any one of the standard makes of industrial electric motor vehicles, thereafter providing only the drivers, paying the insurance charges, and making their own provision for depreciation. All other charges will be borne by the electric supply company under the terms of its contract. The latter provides for the maintenance of the vehicle in every respect, the basis charge being determined on the experience that most electric vehicles can be operated satisfactorily on a single battery charge per day. Where excess mileage is necessary, "boosting" charges will be furnished, the so-called "excess" over the standard service allowance being charged to the client at a figure which includes allowances for tire wear, renewal of worn parts, and other elements covered by the service, in addition to the cost of the extra energy put into the battery. The system throughout is based on the theory that the amount of energy taken out of the battery denotes the service the vehicle is yielding, and in that way measures its periodic requirement for maintenance.

Careful examination of performance records and maintenance outlays for large installations extending over considerable periods have enabled the company to fix upon a figure that assures it ample protection against loss, whilst at the same time affording the client a complete service guarantee at no advance over the ordinary costs for maintenance under the usual garage conditions. As a large buyer of tires, battery replacements, and other supplies, the company is naturally able to give service at a minimum of cost, figuring a safe operating margin on the basis of averages. The new maintenance system is not to be confused with the usual battery service systems which are in operation in various parts of the United States, for the reason that it comprises complete maintenance of the vehicles, including the supply of electrical energy, whereas the battery service system generally only comprises the supply of energy and battery maintenance.

AN APPROXIMATE METHOD OF CHECKING THE ACCURACY OF A DIRECT-READING INSULATION TESTING SET.

By G. W. STUBBINGS.

Such direct-reading instruments for the measurement of insulation resistance as the Megger and Ohmer are in very common use, owing to their convenience and portability. They enable insulation resistance to be tested at a much higher voltage than do such galvanometer and portable battery sets as the Kelvin, while they possess the important advantage over other testing sets requiring a pressure supply from the mains, of being available for use anywhere. There is, however, no direct method of checking the accuracy of direct-reading instruments except by the use of standard high resistances. The comparison of the insulation resistance of, say, a piece of defective cable, as measured by a Megger at 500 volts, with a corresponding measurement using a Paul set taking pressure from 240-volt lighting mains would give no reliable indication of the relative accuracy of the two instruments, owing to the difference of the voltages. Standard resistances even as high as one megohm are, on the other hand, costly, certainly too much so to justify purchasing them for this isolated use. The purpose of the present article is to suggest a method of checking the accuracy of direct-reading testing sets, by using a moderately high resistance in series with an E.M.F. opposed to that of the magneto generator. The apparent resistance of such a combination can be made as high as may be desired by adjusting the difference between the counter E.M.F. and the voltage of the generator.

The principle of the action of direct-reading insulation testing sets may be briefly recapitulated. They depend

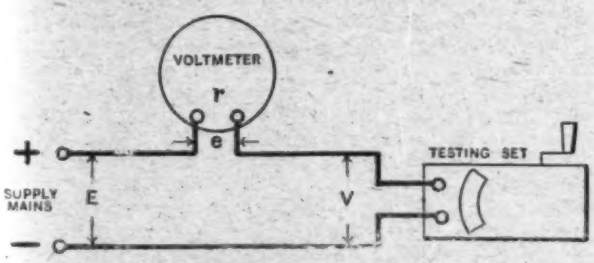


Fig. 1.—Diagram of Connections.

upon the interaction of two magnetic or electrical fields, the one proportional to the voltage of the generator, and the other proportional to the leakage current through the fault. As this leakage current will be proportional to the voltage of the generator, the fault resistance meanwhile being constant, it follows that a variation in such voltage will affect both fields to an equal extent, and will have no effect on the readings of the instrument.

If such a direct-reading set be connected up to a high resistance in series with an E.M.F. opposed to that of the generator, the current through this resistance will depend upon the difference between the counter E.M.F. and the voltage of the generator, and the apparent resistance as indicated by the instrument will be higher than the actual value. If V be the voltage at the terminals of the instrument, E be the back E.M.F., and r the value of the resistance used, the current will be $(V - E)/r$, and the apparent resistance R, will be given by $R = V r/(V - E)$. If the voltage across the resistance be e, then $e = V - E$ and $R = r(R + e)/e$.

The method can be readily adapted by using the supply mains as the counter E.M.F., and an ordinary voltmeter whose resistance is known. The value of e can then be read off directly. The instrument will then be connected up as shown in the diagram, fig. 1, the connections being such that the voltmeter reads backwards before the generator handle is turned. When the generator volts are equal to the supply voltage the voltmeter reads zero, and the testing instrument reads "infinity." On raising the generator voltage, the reading of the testing instrument diminishes, whilst that of the voltmeter increases. By taking simultaneous readings of the testing instrument and of the voltmeter, a very complete check can be obtained.

Assuming a supply voltage of 480, and a voltmeter reading 500 across the scale, such voltmeter will have a resistance of about 50,000 ohms. By regulating the speed of the generator armature to obtain readings of 5, 10, 15 and 20 on the voltmeter, values of R, the apparent resistance of the voltmeter, will be respectively 4·85, 2·45, 1·65 and 1·00 megohms. The method will only give approximate results for high values of R, as the corresponding values of e are observed on the low part of the voltmeter scale, but the accuracy will be sufficient to be very useful.

For checking values of R below 1 megohm a lower voltage should be used. This can be readily obtained by connecting a number of lamps in series across the outer lighting mains, and taking tappings at suitable points. The testing set can then be tested over its whole range without there being any need for an excessive generator voltage.

SPECIALISING AND SPECIALISTS.

By "TRAMP ROYAL."

It was during the war that I sat in the office at Berlin and learnt from my colleagues and the daily Press that England was crushed and the British Empire a thing of the past. At that time I could hardly class myself as either a specialist or an all-round man—for it was the Boer War to which I refer. What I am now is another story; but at that time I had great ideas upon specialisation, and I was developing in the hotbed of the genuine article. I saw men who earned their meagre salary checking strains and stresses in designs of building work, others who made steam calculations, and others who handled railway track problems day in and day out. I rubbed shoulders with foremen who were thoroughly trained as foremen, and workmen who were trained to do their bit skilfully, but to leave the thinking to others. We British—yes, and our American cousins—have felt the results of these intensive methods for many years. The German, in spite of his broad elementary and secondary education, falls easily a victim to the specialist mycelium; he soon loses both adaptability and initiative. The American, as an individual, is not a specialist, but rather a mass of energy in a groove. Although, generally speaking, he is a routinist, he is ever ready to tackle a new problem in a new way, because he has an inherent sense of adaptability.

In a little over a hundred years ago it was possible to grasp all the knowledge there was to be had of modern science; but, at the present time, no individual can know all the facts that have accumulated. Science and technology have now become so much broken into sections that if one is to be a useful worker one must specialise. Driven to this conclusion, we immediately set to work to shut ourselves in watertight compartments, and, making a mental picture of ourselves as specialists, we run the risk of losing grip of the general trend of science.

It is the exceptional man who becomes the real specialist—he is the "expert" *par excellence*; but to most of us is left the choice between a superficial covering of a large area and a developing of one's strong points. For efficiency, the latter choice must be made. How pleasant it is to find that the division of labour makes it unnecessary for us to learn how to repair boots, starch collars, weave straw hats, and drive a motor-bus before we can put in an appearance at the office. Instead of devoting our energies upon learning a multitude of things, we can concentrate upon a few particular things—such as the prices of raw material, the functions of relays, and the labour problem.

The call becomes daily more urgent for good, all-round men who can specialise. By focalising for a time upon one small subject or line of work, one can get hold of all its details, and at the same time broaden the base of general knowledge. One's line of work at a certain time might make it an advantage to specialise upon cable joints and jointing, and a few years later, perhaps, supply meters or steam traps might offer themselves for concentrated study.

It must be our strong points that we build into our specialities; there is no room for average ability. As the old adage has it, "Strike while the iron is hot." Steep oneself in a thing until it is absorbed. Waste little time over weak spots. Develop the strong points, and continually bring them to bear upon every phase of work. We shall thereby produce, as it were, peaks of maximum experience, and these peaks will coincide with our natural abilities, opportunities for advancement, and external influences. During the process of absorption a few excursions around the edges of the territory of the man higher up will prove an advantage, as they will give a broader view to one's work.

The engineer who is not a specialist, but who makes a speciality of some small item, and gets thoroughly in touch with its bearing upon general experience, not only tends to become an expert, but really increases his efficiency in his more expansive every-day line of work. The man with this broad mental scope and ability to concentrate often beats the ordinary specialist on his own ground. There is a psychological reason for this: the mind being brought to bear continually upon a subject a stage is reached which one might call the point of saturation. In economic science there is such a thing as the Law of Diminishing Returns, which applied to specialisation means that if we work at one thing several hours we progress; more hours and we gradually fall off in production; go on increasing the hours, and we reach a stage at which our subject becomes unproductive or stagnant.

On all sides we find Nature specialising: Special organs for digestion, special developments for different geological ages, and it is only by specialising that many members of the animal kingdom are able to exist. They are not specialists, but they have developed a special function or organ. The Pholas specialises in rock or timber boring, its shell being of the nature of a round file. Its activities are limited; it cannot crawl and it cannot crack nuts. The burying beetle, on the other hand, cannot bore rock, but has its body specialised into a digging machine, and its labours are limited to those of grave-digger. A bird, which is higher in the scale, can fly, use its beak as a pick, pair of pliers, or tongs; it can walk, and sometimes swim. The hand of man can be trained to the art of using the saw or gimlet, equally with that of holding a plough, using a needle, or a pair of compasses. He can travel on land, in water, and in the air. Specialising for him must mean more than a rut—it must mean a cutting edge with a solid backing.

In conclusion, I would recommend cultivating a genuine interest and a warm enthusiasm for one's work. No matter what kind of work comes our way, make it individual—give it something characteristic. Remember that the man who can adapt himself readily, but has only ordinary ability, is often found holding a good position, while our brilliant class-mate is unable to land the responsible job because he is too clever to stick at the details and drudgery.

WAR PRICES FOR ELECTRICAL ENERGY.

As in every other department of industry, one effect of the war has been to increase the cost of production of electrical energy and to necessitate increases in the prices charged to consumers. Such advances have been chronicled in our "Lighting and Power Notes" from the commencement, but necessarily are distributed over a great number of issues, as hardly a week passes without an instance arising. From inquiries which have reached us, we infer that the subject is of considerable interest to many of our readers, and have therefore thought it well to bring the data together into a compact form in which they will be readily accessible; the list is not exhaustive, but will probably be found to contain sufficient information for most purposes, and we shall be glad of the assistance of supply engineers, to enable us to bring it up to date on future occasions, if necessary.

The figures given below are additive except where otherwise stated. L. = lighting, P. = power, H. = heating, C. = cooking, T. = tramways, R.V. = rateable value; where not otherwise specified, the increases are understood to apply to all supplies. In the case of complicated tariffs, only the main features are given. The names of months indicate approximately the quarter in which the increase took place (usually following the month named). Prices in pence are per unit.

Aberdeen.—Oct., 1915, L. 10 per cent., P.H.C. 25 per cent.
Abertillery.—March, 1916, L. ½d.; Oct., 1916, L. 1d.
Aberystwyth.—Dec., 1915, 10 p.c.; July, 1916, 10 p.c.
Accrington.—May, 1915, 20 p.c.; March, 1917, L. 0.2d., H. 0.1d., R.V. 0.1d., P. 10 p.c.
Acton.—May, 1915, 10 p.c.; Nov., 1915, min. per qr. 12s. 4d.
Aldershot.—March, 1916, L. 10 p.c., P.H. rev. prices, 2d.—1½d.; Dec., 1916, rev. prices, L. 6d., P.H. 3d.—2½d.
Aldrington.—June, 1915, ½d.
Ashton-under-Lyne.—March, 1916, L. 10 p.c., P.H. 25 p.c.; Dec., 1916, L. pre-war price plus 1d.
Atherton.—Dec., 1915, P.H.C. 20—10 p.c.
Aylesbury.—March, 1916, L. 10 p.c., P. ½d.
Bacup.—Dec., 1917, L. 10 p.c., P.H. 15 p.c.
Bangor.—June, 1915, L. inc. to 6d.
Barking.—April, 1915, 10—5 p.c.; Aug., 1916, rev. price, P.H. 1½d. plus 5 p.c., to 1d.
Barnsley.—June, 1916, L. ½d., P. 10 p.c.
Barnstaple.—June, 1916, inc. to 6d.
Barrow.—Sept., 1915, L.P.H. 10 p.c.
Bath.—Sept., 1915, 10 p.c.; Dec., 1916, 10 p.c.; Sept., 1917, L. ½d., H. 5 p.c.
Batley.—Sept., 1917, L. 7½ p.c., P. 2½ p.c.
Beckenham.—June, 1915, 15 p.c.; June, 1916, L. inc. to 7d.
Bedford.—March, 1916, 5 p.c.; Sept., 1916, 5 p.c.
Belfast.—July, 1915, L. ½d., P. ½d.; July, 1917, ½d.
Bexhill.—Sept., 1915, 10 p.c.; July, 1916, 5 p.c.
Birkenhead.—Dec., 1915, 7½ p.c.; March, 1916, rev. prices, L. 4d., P.H. 1½d. to 1d., plus 10 p.c.; March, 1917, L. 5 p.c.
Birmingham.—March, 1916, L. 15 p.c., P. 20 p.c.; Dec., 1916, L. 15 p.c., P. 10 p.c.; Sept., 1917, 15 p.c.
Bispham.—Jan., 1917, rev. price, P. 2d.
Blackburn.—Oct., 1915, 15 p.c.
Blackpool.—June, 1915, 10 p.c.; June, 1917, rev. prices, L. 4½d., or 7d. and 2d., P. 3½d. and 1d., H.C., 1d.—1½d.
Bognor.—Nov., 1916, 1d.
Bolton.—May, 1915, L. ½d., P. 10 p.c.
Bootle.—June, 1916, 12½ p.c.
Bray (Wicklow).—Sept., 1917, 10 p.c.
Bridlington.—April, 1916, rev. prices, L. 5½d.—4d., H. 2d.—1½d.
Brighton.—March, 1915, L. ½d., m.d. 6d. and 2d. raised to 6d. and 3d., public lighting, ½d., P. 0.1d.; Oct., 1915, L. ½d., P. 0.15d., T. 0.05d.; March, 1916, rev. prices, L. 6½d.—4d., P. 1½d.—1½d.; June, 1917, 10 p.c. (T. 0.1d.).
Bristol.—April, 1917, L. 22½ p.c., P. 45 p.c., Contract 37 p.c.
Broadstairs.—Sept., 1915, 10 p.c.
Bromley (Kent).—July, 1915, 10 p.c.
Burnham (Somerset).—Dec., 1916, 1d.
Burnley.—Aug., 1915, rev. prices, L. 3½d., H. 1½d., P. plus 5 p.c.; March, 1916, L.H.C. ½d., T. 0.05d., P. 5 p.c.
Burton-on-Trent.—March, 1916, 15 p.c.
Bury (Lancs.).—June, 1915, L. 10 p.c., P.H. 15 p.c.; June, 1916, L. 5 p.c., P.H. 10 p.c.; Sept., 1917, 5 p.c., making total L.H.T. 20 p.c., P. 20 p.c.
Buxton.—Sept., 1917, 20 p.c.
Canterbury.—May, 1916, ½d.
Cardiff.—March, 1917, 5 p.c.
Carlisle.—Sept., 1917, 10 p.c.
Caterham.—July, 1916, rev. price, 7d.
Chatham.—March, 1915, 20 p.c.; March, 1916, 13½ p.c.; Sept., 1917, rev. prices, L. 6d., P. 1½d., H. £1½ p. qr., spl. rates 10 p.c.
Cheltenham.—June, 1917, 10 p.c.
Chester.—Dec., 1915, 15 p.c.
Chesterfield.—Aug., 1915, 12½ p.c.
Chichester.—Dec., 1915, 1d.
Chislehurst.—July, 1915, 10 p.c.
Clones.—Oct., 1915, 1d.
Colchester.—July, 1915, ½d.
Colne.—June, 1915, P. ½d.; March, 1917, increase.
Colwyn Bay.—June, 1916, ½d.
Coniston.—May, 1917, 2d.
Cork.—June, 1915, 10 p.c.
Coventry.—July, 1916, P. 2 to 16 p.c., according to price of coal.
Crewe.—June, 1916, 10 p.c.; June, 1917, 15 p.c.
Croydon.—March, 1915, L. ½d.; June, 1916, 10 p.c.; Dec., 1916, rev. price, P. 2½d. to 600 units, 1d. over; Sept., 1917, 15 p.c.
Dalkeith.—July, 1915, rev. price, L. 5½d., P.H. 2d.; July, 1916, L. ½d., P. special charge.
Darlington.—June, 1915, L. ½d., P. ½d.
Dartford.—Sept., 1915, L. 1d. and ½d., P. ½d.; March, 1916, 20 p.c.; July, 1917, L. 10 p.c., P. 15 p.c.
Darwen.—June, 1915, L. 10 p.c., P. 20 p.c.; June, 1916, P. 5 p.c.; June, 1917, 5 p.c.
Dawlish.—Aug., 1916, L. 10 p.c.
Denny.—Sept., 1916, L.P. ½d.
Dewsbury.—June, 1915, L. 10 p.c., R.V. 12 p.c., P.H. 15 p.c.; June, 1917, L. and R.V. 2½ p.c., P.H. 10 p.c.
Dover.—Sept, 1916, ½d.
Dublin.—March, 1915, L. ½d., P. ½d.
Dundee.—June, 1917, L. ½d., P. ½d.
Durham.—June, 1915, 0.02d. for every 6d. above 7s. cost of coal per ton.
Ealing.—Aug., 1916, 33.3 p.c.
Eastbourne.—March, 1916, L. ½d.; Sept., 1916, L. ½d.
East Ham.—Dec., 1915, 10 p.c. (T. 5 p.c.); June, 1917, 10 p.c. (T. 5 p.c.).
Eccles.—Sept., 1915, L. 10 p.c., P.H.C. 20 p.c.; Dec., 1916, L. 15 p.c., P.H.C. 5 p.c.
Edinburgh.—July, 1915, L. ½d.; Aug., 1917, L. ½d., P. 5 p.c.
Elland.—July, 1915, P. 12½ p.c.; Aug., 1916, L. ½d., P. 7½ p.c.
Epsom.—March, 1916, 25 p.c.; March, 1916, rev. prices, L. 7d., P. 3½d., public lighting 4½d.
Erith.—Sept., 1915, L. ½d., P. 10 p.c.
Exeter.—June, 1916, L. 1d.
Falkirk.—April, 1915, 30 p.c.
Farnham.—Dec., 1916, rev. prices, L. 6d., P.H.C. 4d. (restricted).
Faversham.—Oct., 1915, ½d. Sept., 1917, ½d.
Finchley.—June, 1916, L. 20 p.c., P. 10 p.c. and scale.
Fleetwood.—Sept., 1915, 10 p.c.
Great Yarmouth.—July, 1915, ½d.; Dec., 1915, ½d. with rebate.
Gillingham.—April, 1915, L. ½d.; Dec., 1915, 10 p.c.; Oct., 1916, 15 p.c.; Aug., 1917, 15 p.c.
Glasgow.—June, 1917, rev. prices, L. 5d. and 1½d., or 4½d., P. 2d. and 1d., and scale, H. 1½d. or 1d., kw. charge inc. 15 p.c.
Gloucester.—July, 1916, 20 p.c.; June, 1917, 13.3 p.c.
Gravesend.—March, 1916, 25 p.c.
Grantham.—June, 1916, 20 p.c.
Grays.—June, 1915, 10 p.c.; June, 1916, 15 p.c.; July, 1917, 8.3 p.c.
Grimsby.—Oct., 1915, ½d.
Guildford.—Sept., 1915, L. 10 p.c., P.H.C. 20 p.c.
Halifax.—Sept., 1916, P. 17½ p.c.
Hampton.—July, 1916, 20 p.c.
Haslingden.—June, 1917, rev. prices, L. 4½d., P.H. 15 p.c.
Hastings.—Sept., 1915, L. 10 p.c.; Dec., 1915, 10 p.c.
Hebden Bridge.—Dec., 1916, L. 20 p.c., P. 25 p.c.
Heckmondwike.—June, 1915, 10 p.c.; July, 1917, 33.3 p.c., making L. 6d., P. 2d. and 4d.
Hereford.—May, 1915, 10 p.c.; May, 1916, 25 p.c.
Heston and Isleworth.—March, 1917, 25 p.c.
Hexham.—June, 1915, L. 1d.; Sept., 1916, L. 1d., P. ½d.
Heywood.—May, 1915, 10 p.c.; Dec., 1915, L. 5 p.c., P. 10 p.c.
High Wycombe.—June, 1915, 10 p.c.
Hornsey.—March, 1916, 10 p.c.
Horsham.—March, 1917, rev. prices, L. 6d., P.H. 2d.
Hove.—Sept., 1915, 20 p.c.; Sept., 1917, P. 10 p.c., or flat rate 2d.
Huddersfield.—June, 1915, 12½ p.c.; Sept., 1916, 12½ p.c.
Hull.—Dec., 1915, ½d., or 15 p.c.
Ilford.—March, 1916, 12½ p.c.

Ilkeston.—March, 1916, rev. prices, L. 4d., P. 2½d.-1½d., H. 1½d.
Ipswich.—June, 1915, L. ½d., P.H.C. and R.V. 10 p.c.; March, 1916, L. ½d., P.H.C. 15 p.c.
Keighley.—Sept., 1915, ½d.
Kendal.—June, 1915, L. 1d., P. ½d.
Keswick.—June, 1916, L. 10 p.c.
Kettering.—June, 1915, P. 10 p.c.
Kingston-on-Thames.—April, 1915, rev. prices, L. 5d. or 7½d. and 3½d., P.H.C. 1.65d.; April, 1916, R.P.L. 6½d.—4½d., P.H.C., 1½d.—1d.
King's Lynn.—July, 1915, L. ½d., P. 5 p.c.; Jan., 1916, P. 5 p.c.
Lancaster.—April, 1916, ½d.; April, 1917, L.P. 22 p.c., T. 12½ p.c.
Leek.—June, 1915, 10 p.c.
Leicester.—July, 1915, L. ½d., P. 20 p.c.; March, 1917, L. 1d., P. 15 p.c.
Leigh (Lancs.).—June, 1917, L. 15 p.c.
Leyton.—March, 1916, L.P.H. 15 p.c., T. 5 p.c.
Lincoln.—Dec., 1915, L.P. 20 p.c.
Liverpool.—Dec., 1915, 12½ p.c.
Llandrindod Wells.—July, 1916, 1d.
Llandudno.—Aug., 1915, ½d.

London Companies.—
Brompton & Kensington.—Sept., 1917, total inc. 20 p.c., clng. 1d.
Charing Cross, West End & City.—June, 1916, rev. prices., 5d., 4d. & 2d.
Chelsea Electric Supply Co.—Sept., 1917, 20 p.c.
City of London.—March, 1915, P. 10 p.c.; March, 1916, 10 p.c.; June, 1917, public lighting 15 p.c.
Kensington & Knightsbridge.—Dec., 1916, rev. price 5½d.
London Electric Supply Corporation.—Sept., 1917, total increase from 20 to 30 p.c..
Metropolitan Electric Supply Co.—Sept., 1917, total inc. 20 p.c.
Notting Hill Electric Supply Co.—March, 1915, ½d.; Sept., 1916, ½d.; total inc. 20 p.c.
South London Electric Supply Co.—Dec., 1915, 9 p.c.
South Metropolitan.—March, 1915, 10 p.c.

London Borough Councils.—
Battersea.—Sept, 1915, 10 p.c.
Bermondsey.—June, 1917, L. 40 p.c., P. 50 p.c.
Bethnal Green.—Sept., 1917, 33.3 p.c.
Fulham.—March, 1915, 5 p.c.; Dec., 1915, rev. prices, L. 4d., P. 1½d.; March, 1917, 5 p.c.; May, 1917, kw. system, plus 0.0075d. p.u. for each 6d. over 13s. cost of coal per ton.
Hackney.—Sept., 1915, 10 p.c.; Feb., 1916, 7½ p.c.; Sept., 1916, L. 2½ p.c., P. 12½ p.c.; June, 1917, 10 p.c.
Hammersmith.—Sept., 1917, L.P. 12½ p.c.
Hampstead.—Sept., 1916, 10 p.c.; Dec., 1916, 23.3 p.c.
Islington.—Dec., 1916, 25 p.c.
Poplar.—March, 1916, P. and public lighting, 10 p.c.; Sept., 1917, 10 p.c.
St. Marylebone.—Sept., 1915, 10 p.c.
St. Pancras.—June, 1915, 10 p.c.; Sept., 1917, reduced to 2½ p.c.
Shoreditch.—March, 1917, L.P.H., 25 p.c.
Southwark.—Jan., 1917, total increase equal L. 30 p.c., P. 50 p.c.; Sept., 1917, rev. prices, L. 6d.—3d., two-rate L.P. 8d. and 2d.
Woolwich.—March, 1915, ½d.

Long Eaton.—June, 1915, rev. prices, L. 4d., factory 3½d. and 2½d., P. 1½d. and 0.85d., H. 1d.
Loughborough.—Sept., 1915, 12½ p.c.; Dec., 1916, 12½ p.c.
Lowestoft.—March, 1916, L.H. 10 p.c.; May, 1917, L. ½d., P.H. 10 p.c.
Maidenhead.—Sept., 1915, L. ½d., P. 10 p.c.; April, 1916, L. ½d., P. 10 p.c.; July, 1917, L. 1d., P. 10 p.c.
Maidstone.—Dec., 1914, P. ½d.; April, 1915, L.H., ½d.; Dec., 1915, L. ½d.; March, 1916, H. reduced to 1d.; June, 1916, rev. prices equal 25 p.c. inc. on original prices; Aug., 1917, L. ½d., T. ½d., other 10 p.c.
Malton.—March, 1916, 20 p.c.
Malvern.—May, 1915, 1d.
Manchester.—May, 1915, L. 10 p.c., P. 15 p.c., R.V. from 12 to 15 p.c.
Merthyr Tydfil.—June, 1915, rev. price, ½d.
Mexborough.—July, 1916, rev. price., L. 4d.
Middleton.—June, 1915, L. ½d., P. 12½ p.c.; March, 1916, L. ½d., P.H. 12½ p.c.
Mirfield.—May, 1915, P. and public lighting, 10 p.c.
Morecambe.—June, 1917, rev. price, P. 3d.
Newcastle-under-Lyme.—May, 1916, L. 5 p.c., P. 16.7 p.c., P. 20 and 10 p.c.; Oct., 1916, rev. price, L. 7½d.
Newport (Mon.).—June, 1915, 20 p.c.; June, 1917, 10 p.c.
Newport (I.O.W.).—June, 1916, L. 15 p.c., P. 10 p.c.
Newquay.—Dec., 1914, rev. price, 7d.
Newton Abbott.—July, 1915, 16 p.c.
Northampton.—Sept., 1915, L. 10 p.c., P. 7½ p.c.; Sept., 1916, L.H. 10 p.c., P. 12½ p.c.; June, 1917, 10 p.c.
Northwich.—June, 1916, 10 p.c.; June, 1917, rev. prices, 7d. and 4½d., flat rate 6d.
Nuneaton.—June, 1917, 20 p.c. (P. 10 p.c.). Sept., 1917, total inc., 33.3 p.c.
Ormskirk.—Nov., 1915, L. 10 p.c.
Oxford.—June, 1916, 20 p.c.
Pembroke (Dublin).—March, 1915, L. 5 p.c.
Perth.—Aug., 1916, L. 12½ p.c., P. 5 p.c.; Aug., 1917, 40 p.c.
Peterborough.—Sept., 1915, P. ½d.; Oct., 1915, 10 p.c.; Sept., 1917, total increase 20 p.c.
Portsmouth.—Dec., 1917, total increase will equal L. 30 p.c., P.H. 45 p.c.
Plymouth.—Sept., 1915, L. ½d.
Preston.—June, 1915, L. ½d.
Queensborough.—Dec., 1915, 15 p.c.
Radcliffe.—Sept., 1915, L. 10 p.c., P.H. 15 p.c.; July, 1916, L. 5 p.c., P.H. 10 p.c.
Rathmines.—June, 1916, L. ½d., P.H. ½d.
Rawtenstall.—June, 1916, P. 5 p.c.
Reigate.—March, 1916, L.P. 15 p.c., H. ½d. plus 15 p.c.; April, 1917, 13.3 p.c.
Richmond (Surrey).—April, 1915, 10 p.c.; Nov., 1916, rev. price, 4½d.
Rochdale.—June, 1915, L. 10 p.c., P.T. 15 p.c.; May, 1917, L. 10 p.c., P. 3d. instead of 15 p.c. Also coal clause.
Rotherham.—July, 1915, L. ½d.
Rowley Regis.—Aug., 1916, 20 p.c.
St. Annes-on-Sea.—June, 1915, L. ½d., P.H. 10 p.c.; April, 1917, inc.
St. Helens.—June, 1915, L. 10 p.c.; July, 1916, 10 p.c.; Dec., 1916, 10 p.c.; April, 1917, 10 p.c.
Salford.—June, 1915, L.P. 7½ p.c.; March 1916, L. 2½ p.c., P. 7½ p.c.
Scarborough.—June, 1915, 10 p.c.
Sheffield.—July, 1916, prices over 2d., 10 p.c.; under 2d., 20 p.c.
Shipley.—June, 1915, rev. price, L. 4½d., P. 10 p.c.; March, 1916, P. 10 p.c.
Shrewsbury.—March, 1916, 20 p.c.; June, 1917, 13.3 p.c.
Sleaford.—March, 1917, L. ½d., P. ½d.
Southampton.—June, 1916, 10 p.c.; Sept., 1916, 10 p.c.
Southend-on-Sea.—June, 1917, L. ½d., P. ½d.
Southport.—June, 1915, 10 p.c.; June, 1917, 5 p.c.
Southwold.—March, 1916, 20 p.c.
Spenborough.—June, 1915, rev. prices, L. 4½d., P.H. 2½d. and 1½d.; April, 1917, R.P.L. 5½d., P. 2½d.
Stafford.—June, 1916, P. ½d.; Sept., 1916, rev. price, L. 7½d.
Stalybridge.—Dec., 1915, P. (on prices less than 1d.) 0.1d.
Stamford.—July, 1915, 10 p.c.
Stockport.—June, 1915, rev. prices, L. ½d., H. 1½d. (above 25 units, existing rates plus 10 p.c.); P. coal clause.
Stoke-on-Trent.—June, 1917, 25 p.c.; Sept., 1917, 33.3 p.c.
Stowmarket.—April, 1917, price raised from 8d. to 10d.
Stratford-on-Avon.—April, 1916, 1d.; August, 1917, ½d.
Stretford.—Aug., 1915, L. 10 p.c., P. 15 p.c.; Oct., 1915, 15 p.c.
Sunderland.—March, 1916, ½d.
Surbiton.—March, 1916, 1d.; March, 1917, 1d.
Sutton.—July, 1916, L. ½d., P.H. ½d.
Swansea.—Sept., 1915, hours of m.d. inc. from 91 to 137 in winter qr., meter rent adopted.
Swindon.—Sept., 1915, L. 12½ p.c. or ½d., P. 12½ p.c., public lighting and T. 10 p.c., H.C. ½d.; Sept., 1916, L. ½d.
Taunton.—Sept., 1915, 15 p.c.; June, 1916, 10 p.c.; March, 1917, 6.3 p.c.
Teddington.—June, 1916, 20 p.c.
Thirsk.—April, 1916, 20 p.c.
Torquay.—Sept., 1916, L. ½d.; June, 1917, ½d.
Trowbridge.—Aug., 1916, 10 p.c.
Tunbridge Wells.—Sept., 1917, L. 10 p.c., P.H., 23 p.c.
Wakefield.—Sept., 1915, L.P. 12½ p.c.; April, 1916, P. 12 p.c.
Wallasey.—July, 1915, rev. prices, L. 4d. and 3½d., P. 2½d., H.C. 1½d.
Walthamstow.—June, 1915, 15 p.c.; Nov., 1916, L. 5 p.c., P.H. 10 p.c.; Sept., 1917, L. 5 p.c., P.H. 8.3 p.c.
Walton-on-Thames.—Sept., 1916, rev. price, 7d.
Warrington.—July, 1915, L.T., 10 p.c., H.P. 15 p.c.; July, 1916, 5 p.c.; June, 1917, 10 p.c.
Watford.—June, 1915, L. 12½ p.c., P. 10 p.c.; Sept., 1916, rev. prices, L. 5½d.
Wednesbury.—Dec., 1914, 15 p.c.
West Bromwich.—June, 1915, 20 p.c.; Dec., 1915, P. 15 p.c.
West Ham.—Sept., 1917, 10 p.c. Sept., 1917, further 10 p.c.
West Hartlepool.—Sept., 1917, 15 p.c.
Weymouth.—April, 1916, L. 15 p.c., P.H.C. 20 p.c.; Sept., 1916, rev. price, L. 6d.
Wigan.—March, 1917, rev. prices, L. 5½d. to 3½d.; Sept., 1917, rev. prices, P. 2d.—1d., plus 25 p.c.
Wimbledon.—March, 1916, 10 p.c.; Sept., 1916, 15 p.c.; Sept., 1917, rev. prices, L. 6d., P.H.C. 2d.
Winchester.—Sept., 1916, 15 p.c.; Dec., 1916, 10 p.c.
Windermere.—June, 1916, 10 p.c.
Wisbech.—June, 1916, inc. to 6½d.
Wolverhampton.—June, 1916, 10 p.c.
Worcester.—Oct., 1915, L.P.H. 10 p.c.
Worksop.—Sept., 1915, L. ½d., P. ½d.; May, 1917, ½d.
Worthing.—Oct., 1915, L. 10 p.c., or total 5½d.; Jan., 1917, 20 p.c.
Wrexham.—Dec., 1916, 10 p.c.; Sept., 1917, L.H. 15 p.c., P. 6.7 p.c.
York.—March, 1917, L.P. 10 p.c.

AFTER-THE-WAR ELECTRICAL PROBLEMS IN RUSSIA.

Amongst the technico-industrial problems that will come to the front in consequence of the war a very prominent place will be occupied in the post-war era, undoubtedly, by the question of the quickest and most reasonable development of the application of electricity in Russia. Unfortunately, no country previously to the war worked so unreasonably, dearly, wastefully, and unproductively as Russia; and of the various branches of Russian industry, as will be shown below, the Russian electrotechnical industry has been marked by these negative properties to a particularly large extent, says P. Gurievitch in the *Elektrichestvo*. Whilst in Germany, in the years 1900-10, district stations were reasonably introduced, and in the last five years a further great step forward has been made in so-called "grosskraftwerke"—that is, large stations for the supply of electric current to whole provinces, and even whole Governments—the Russian electrical industry has not emerged from the stage of uneconomical local electrical stations. The large power station using water power or brown and grey coal has not yet emerged from the sphere of platonic desire and project. In this irrational and uneconomic management of Russian local electric stations we find, however, a great danger for the whole future of industrial development in Russia.

The great progress made by the electric lamp in Europe and America, which he describes, leads M. Gurievitch to say that the supersession of the kerosene lamp by the electric lamp, owing to advantages of the latter over the former from the point of view of hygienic and sanitary conditions in the houses and workmen's dwellings, and also the greater safety in regard to fire, will become intensified in Russia in the near future, the more so as with the rational installation, production, and distribution of electrical power, electric lighting, at least in the towns, can easily compete with gas, and even with kerosene lighting. Gas and kerosene have their particular spheres of application where electricity, at least in the near future, cannot compete. A great future is in store, without doubt, in the large towns for gas for cooking, and for kerosene and petroleum as fuel for internal combustion engines. In the Russian Press the need is being urged of extending gas lighting, because in Russia a great need is being experienced for by-products of gas production required for the manufacture of explosives; but no doubt such can be obtained in sufficient quantity by the transformation of all the Russian coking furnaces for the recovery of the waste or by-products. With the chronic scarcity of coal in Russia, and the urgent necessity of it for the metallurgical industry, the burning of coal for lighting purposes appears to be, from the point of view of economy, altogether inadmissible, as electrical power can be successfully obtained by the use of cheap fuel—such as brown coal, peat, and the many water courses.

The writer then points out the increasing application of electricity to power purposes, which is leaving the lighting factor in the background; and to show how year by year this is taking place, he provides the following table, which includes the figures for Petrograd and Moscow :—

Year.	Berlin. 1911-12.	Chicago. 1911.	London. 1910-11.	Moscow. 1913.	Petrograd. 1913.
Population in millions...	2·6	2·2	6·5	1·5	2
Useful KW.-hours delivered per head of population ...	170	310	110	87	62·5
Delivered for lighting, per cent.	24	19	61	19	39
Motors, per cent. ...	45	12	27	40	33
Tramways, per cent. ...	31	69	12	41	28

This, he urges, shows that only in London and Petrograd has the delivery of electrical energy for lighting purposes surpassed that for other forms of application. In Chicago and Moscow only a fifth and in Berlin only a quarter of the total useful energy was delivered for lighting. Chicago, true, is in a somewhat special position, as a very large quantity of its power is used for the underground railway, whilst in Berlin 45 per cent. and in Moscow 40 per cent. is used exclusively in motors.

In Berlin 35,000 motors were connected in 1913-14, including 6,900 with 24,000 KW. for working metals; 4,755, with 29,000 KW. for lifts; 3,741, with 11,000 KW. for wood working; 3,723, with 8,861 KW. for printing presses; 3,329, with 1,253 KW. for fans; 1,920, with 5,814 KW. for sausage and meat shops; 1,638, with 1,066 KW. for sewing machines, &c. All these data are very interesting, as they illustrate the immense development possible for the introduction of electric motors in the large Russian towns, of which in 1913 there were connected in Moscow (1912), 6,976 electric motors; in Petrograd (1913), 6,851; in Warsaw (1913), 3,103; and in Lods (1912), 2,404 electric motors.

About the same movement in the development is observed in Russia, where in 1913 the four towns with the largest electric stations used only 82,000,000 KW.-hours for lighting, but 207,000,000 KW.-hours for motors, &c., and 89,700,000 KW.-hours for tramways. With a total delivery in these towns—Petrograd, Moscow, Baku, and Lods—of 378,000,000 KW.-hours, only 21·6 per cent. was supplied for lighting purposes. In all Russia, with the exception of the eight Governments of the Kingdom of Poland, the supply of electric current for lighting purposes, and also for technical purposes and motors, is shown in the following form, in millions of KW.-hours :—

	For lighting.			For motors and industrial purposes.		
	1905.	1913.	Increase, per cent.	1905.	1913.	Increase, per cent.
Central stations	52·1	175·5	238	47·9	444·8	829
Private „	169·8	209·4	23	212·4	1,045·7	393
	221·9	384·9	73%	260·3	1,490·5	473%

We see from this table that the expenditure of electrical energy in the eight years, 1905-13, for lighting purposes only, increased by 73 per cent., whilst the expenditure for motors and other industrial purposes rose 473 per cent. In other words, the application of electricity for motors and general industrial purposes increased during that time 6½ times quicker than for lighting purposes. But if we take Poland into account, the expenditure of electric energy in 1913 for the whole Empire amounted to about 2,000 million KW.-hours, of which only 20½ per cent. was used for lighting and 79½ per cent. for motors, whilst in 1905 the deliveries for lighting made 46 per cent. and for motors 54 per cent. only.

The figures for Lods are particularly striking. There, in 1913, there was supplied for lighting only 3,662,000 KW.-hours, against 27,109,000 KW.-hours for motors. Thus we see that even in Russia, in the towns with a large industrial development, the supply of electric current for motors, excepting tramways, exceeds that for lighting by almost nine times.

The Moscow lighting station delivers over twice as much current for motors as for lighting—namely, 51,677,000 KW.-hours, against 24,812,000 KW.-hours. Of the large Russian industrial centres, only Petrograd is distinguished by its backwardness in the supply of current for motors. There, in 1913, only 41,490,000 KW.-hours were delivered for industrial motors, against 48,745,000 KW.-hours for lighting purposes, and 34,872,000 KW.-hours for the tramways.

In a comparison of the prices of electricity it is observed that, whereas in Berlin the normal price is 16 pfennige per KW.-hour, or 7½ copecks; in Switzerland 16 centimes, or 5·9 copecks, in Russia, according to figures published in the "Elektrichestvo" in 1913, most of the stations accepted normal and small consumers for motors at 15 or 16 copecks per KW.-hour—that is, 100 to 150 per cent. more than in Switzerland or Germany. In these dear tariffs, which may properly be called prohibitive, there is great danger for the whole future of the development of the electrical industry of Russia. Losses in working power in the form of men killed and made incapable of work will make at least 5,000,000 by the end of the war; that is to say, a sixth of the productive power in workers of 19 to 45 years of age, as given in the *Torgovo Promyshlennaya Gazeta* in 1916. But even if, thanks to a reduction of holidays, Saints' days, and holiday Mondays, and preserving the present obligatory sobriety, the productivity of the remaining, five-sixths of the workers is raised to the average level of before the war, such a level is so low in comparison with America, and even Western Europe, that if it is maintained in the future, Russian industry cannot expect, with a whole series of unfavourable conditions of a political, economic, and civilian character, to reach rapidly that stage of development that would enable it by means of a rapid rise in the productivity of the country to recover from the blows of the war, and pass over from the intense (from the economic point of view) unproductivity and exhaustion of war-time work to the productive economy of peace time.

Besides the foregoing, if Russian industry is to operate as previously to the war, then, notwithstanding any protective tariffs whatever, it will not be in a position even on its own market to compete with other countries, whether they be Germany, Japan, or the United States, which during the war have acquired immense capital and established in many branches of industry miracles in the form of factories, the equipment of which before the war is finished will have been paid for completely owing to the large war orders.

But how will Russian industry be in a position to pass over into productive and intensive work?

If we put aside the many causes of a general character that have prevented and will hinder Russian independence, and limit ourselves only to a review of the strictly technical causes that are intimately connected with the question we are considering—namely, the future of the electrical industry in Russia—we may confidently state that one of the chief causes of the limited productivity and dearness in Russian industry is the too limited application of mechanical power.

American industry, as is known, is distinguished by the highest productivity in the whole world, and that is explained, to a large extent, by the fact that, being always short of hands, the Americans were obliged more than in other countries to adopt the principle of attaining the largest possible result with the smallest expenditure possible of labour. After a lengthy examination of the conditions influencing the industries of foreign countries, paying particular attention to fuel, M. Gurievitch lays great stress on the use made of cheap power, as in the case of Switzerland, and adds that Russia belongs to the list of countries that enjoy such advantages, and that therefore the rational development of the production of electrical power is one of the first problems to be dealt with immediately after the war.

If we turn to the present condition of the Russian electrical industry, we shall see that with very few exceptions—for example, the Moscow station—the Russian electrical stations are equipped irrationally in technical respects, and, above all, with old machines. As the still young electrical industry is in a stage of rapid development, it has of recent years made such colossal progress that the machines installed in the Russian stations 10 or 15 years ago, perhaps at the time the very last word in technical equipment, are at this moment quite unsuitable for electric current production.

According to statistics published in 1913 in the "Elektrichestvo," there were, for example, 47 stations with steam engines of a total power of 228,562 KW., besides 70 steam turbines, and, further, 137 steam engines of an old type, about 72 vertical and 65 horizontal, that had worked at the stations in large industrial centres and consumed unprofitably an immense quantity of coal, which is particularly dear in Russia, thanks to which the stations were obliged to retain their abnormally high tariffs for electricity, corresponding to the position of the electrical industry of 10 or 15 years before. Whilst in Berlin the normal tariff for electric light was only 40 pfennige—18·4 copecks—per KW.-hour, in Petrograd it was 30 copecks—that is to say, 63 per cent. dearer. This high Petrograd tariff was due to a whole number of other reasons—dearness of fuel, machinery, and especially cable systems, the creation of three separate companies, with their expensive boards, &c.

But it is certain that in the year 1913 in the Petrograd stations the 25 worn out steam engines, with 15 steam turbines, had a very unfavourable influence on working expenses. If the Russian electrical stations, with their great material expenditure, were modernised, as it is proposed they shall be in Petrograd in the near future, this question of the rational organisation of the production of the electric current in Russia would still remain unsolved as to modernise the existing electrical stations, means at bottom only to limit oneself to patches.

The present basis of the Russian electrical industry rests exclusively on the principle of small local electrical stations with high quality fuel obtained literally from the world's end, and it is essentially irrational and opposed to all the tenets of economy. Every new patch on this unhealthy organism, every new large central station of a local character is only another stumbling block which, in something like ten years, will have to be got over or removed at great expense, as, without a doubt, the Russian electrical industry with the uninterrupted development of things will be obliged in ten years' time, and perhaps before, to change over to the system of large interconnected regional stations which work with water power or cheap brown or grey coal, and are recognised as the only and profitable way for the production of electric current.

That one large electrical station is, in respect to original cost of equipment and current working expenses, more profitable than a series of small stations of equal power is obvious. Here the writer quotes numerous examples of installations in other countries, particularly in the United States, where, all the same, there are many small irrationally exploited electric stations. Thus in 1912 in that country there were 5,221 central stations, of which only 161 had a power of over 5,000 KW., or 3·1 per cent. The same is the case in Germany, where, out of 4,040 stations in 1913, only 103, or 2 per cent., had a power of over 5,000 KW. In Russia, out of 220 central stations only 21, or 5·5 per cent., had a power of over 5,000 KW. This is shown more clearly in the following table :—

—	Year.	Total No. of central stations.	No. of stations of 5,000 KW.	Ditto in per cent.	Power of all stations in KW.	Total power of stations of over 5,000 KW.	Ditto in per cent.
United States	1912	5,221	161	3·1	5,135,000	3,610,000	70·3
Germany ...	1913	4,040	103	2	2,100,000	1,560,000	74·5
Russia ...	1913	220	12	5·5	—*	199,000	—

The Russia item is particularised as follows :—The Moscow electrical station with 35,000 KW.; the Moscow tramways, 23,100 KW.; the Petrograd 1886 Co., 45,000 KW.; the Petrograd Belgian Co., 18,460 KW.; the Petrograd Electrical Equipment Co., 18,000 KW.; the Petrograd tramways, 7,500 KW.; Baku, 29,000 KW.; Warsaw, 11,590 KW.; Lods, 15,000 KW.: Kieff lighting, 7,550 KW.; Odessa lighting, 7,500 KW.; and Riga, 7,060 KW.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Old Lamp Tops.

I note in your issue of September 21st that a correspondent is inquiring as to the best method of recovering platinum from old electric lamp tops. I do not know if he intends dealing with large quantities or only a few thousands at a time. Assuming the latter, the best method to adopt is as follows:—

First of all, break out the cement or plaster and the glass from the caps, then "rough sort" the material obtained in order to reduce the bulk as far as possible. Crush what is left with a pestle and mortar until the plaster, &c., is reduced to a powder. Put the powder on a sheet of white glazed paper, spread on a bench, sit down in front of it, draw a small portion of the powder towards you, and commence blowing it away gently. The platinum and other wire will be left behind. Having done this, sort the wire as far as possible. A magnet should be used for separating the nickel wire, but all wire should be carefully examined for any pieces of platinum which may be attached to it. Put the remainder of the wire in a good porcelain dish, pour pure nitric acid on it, and boil until all the foreign matter is dissolved. Wash well and dry off. The process is a very tedious one, and requires good eyesight. A person can, by sticking at it, recover the platinum from 1,000 lamp ends in eight or ten hours. Needless to say, the boiling should be carried out in the open air, as dense red fumes are given off.

If your correspondent intends dealing with large quantities at a time, it will be necessary to put down special machinery for it.

Harry W. Brown.

Ballycarry, *September 26th*, 1917.

A Static Electricity Phenomenon.

The experience of Messrs. J. O. Grant & Taylor is similar to that which I have met with in connection with a steam car fitted with rubber-tired wheels. In this case a person standing on the ground and touching the metal work of the car would receive an unpleasant shock.

I also remember another case where a steam engine was driving some printing machinery by means of a 12-in. copper-sewn leather belt. When running, sparks 1 in. to 1½ in. long could be obtained from it by bringing the fingers near the belt.

Harry W. Brown.

Ballycarry, *September 20th*, 1917.

[The electrification of belting is a not uncommon phenomenon, due apparently to mechanical friction, or, perhaps, more accurately, to contact followed by separation. In paper mills very long sparks can be drawn from the rolls of hot dry paper as it leaves the calenders.—Eds. Elec. Rev.]

The E.T.U. and A.E.S.E.

Being a central station engineer of many years' standing, I should like to make the following remarks in connection with the letters from the secretary of the E.T.U. (L.D.). I am not a member of the E.T.U., or of the A.E.S.E., but after reading the aforementioned letters I should certainly never join the E.T.U. if those are correct samples of their progressive industry. To hit a Society that stands aside (from purely patriotic motives, and loses a number of its unpatriotic members in so doing) is a very low and unsportsmanlike attitude to adopt, especially to a Society that before the war was slowly bringing about some very essential radical improvements in the welfare of station engineers. To my mind it smacks very much of "beer and skittles," and appears to me *just why* central station engineers who have the least respect for themselves have so far refrained from joining *Unions* of such an unsavoury nature. *Let the status go to blazes if it has to be got thus.*

W. G. Ritchie.

Brighton, *September 28th*, 1917.

Scale on Evaporative Condenser Tubes.

I would advise "Central" to try and prevent the deposit of scale on the tubes by painting the tubes with aluminium paint. It would be interesting to try the effect of this on a small section of the condenser, and I would be very glad if "Central" would let me know the result.

C. Orme Bastian.

London, W., *September 25th*, 1917.

Fusing of an Electric Wire.

I was interested to read your correspondent's article, but I think that he arrives at the wrong conclusion. "The whole question 'is not' one of efficiency . . . . the efficiency of the electrical engineer and his workman." The bulk of his illustrations bring out the fact that the general public think they are quite competent to do electrical work. The draper's assistant and budding electrical engineer, and every other incompetent, thinks he is qualified to interfere with an electrical installation, and that a contractor is quite unnecessary.

As regards the A.C. motors in controlled establishments, these were probably supplied by a wholesale house, or the motor manufacturers, and installed by the firm's own workmen. I know of many jobs which have not been interfered with, which have been "installed and forgotten."

I quite agree with Mr. L. E. Wilson's letter *re* periodical testing, and I think that in apportioning the blame to a large extent to the wholesale house he is getting near the root of the evil.

In a large percentage of installations the following circumstances happen: The installation, as handed over by the contractor, is a sound one. The maintenance is then given to a wireman, engineer, or odd man who looks after the motors and attends to the lights. Extra work is required from time to time, and the man, in addition to his daily work, carries out the extensions, which are very often done in a temporary manner, without any regard to overloading of circuits and other questions, so that in course of time the job becomes anything but a good one; then, if trouble arises, the contractor is blamed, for you cannot expect the man to condemn his own work.

By constituting any odd man about the place as his electrician, the consumer is entitled to trade terms (thanks mainly to the Tungsten Lamp Association), and supply houses, lamp factors, motor manufacturers, and cable makers tumble over one another to supply his wants at trade terms, and assist him in robbing the contractor of his legitimate work. Why should the T.L.A. give terms which make it impossible for a contractor to retain his customers? Why should a motor maker whose motor a contractor has sent direct to a job, be justified in calling immediately on the contractor's customer and offering trade terms? Why should supply houses sell a few dozen accessories or the lamps at trade terms immediately a contractor has finished the installation, and endeavour to cut out the contractor by even going to the length of finding third-rate firms who will fix the material they supply?

Why for a paper cable should cable makers quote exactly the same price to a penny to a consumer as they do to a contractor, seeing that the consumer is only a chance customer and the contractor a regular one, and this, moreover, when the contractor is working for the consumer?

How long is this policy of grab to continue? Is there no honour in the electrical trade? Is the policy of the German firms to be perpetuated by the supply houses, many of whose nationality would not bear the strictest examination? The business policy of the present associations and others in course of being formed bids fair to out-German the German. It is time the contractor made up his mind that, without combining, he will be squeezed out. Let every contractor help those who are determined not to submit to these injustices by joining the Contractors' Association, which has already done good work, and can do much more if backed by the whole of the contractors in the kingdom.

Contractor.

Instructions to Meter Readers.

May I suggest that Mr. Stubbings, in his otherwise thoughtful article concerning the "Do's and Dont's" of meter readers, indicates insufficient appreciation of the commercial value which may attach to a consumer's conversation. It is, of course, extremely difficult to find the valuable combination of salesmanship and ordinary ability to read meters accurately, in the type of individual available to fill posts as meter readers; but I do firmly believe that, however polite may be a request that the consumer address his or her requirements of new work to the office, such request in very many cases would be directly responsible for opportunities of extended service being unhappily lost.

However lowly as an employé the meter reader may be regarded, I think that he or she should be definitely instructed in such a way as to enable appreciation of the valuable chances of further increasing the revenue of the supply undertaking concerned.

It would appear that, to carefully note in writing, and report to the office for attention of the sales department, the requirements of consumers, could be one of the suggested instructions with which your contributor concludes his article, without the disadvantage which, by some, might be thought to result from overlapping.

P. O. Wittey,
Staff Sergeant R.E.

B.E.F., France, *September 29th*, 1917.

War Bonus for W.O. Station Engineers.

Reading the small column in last week's Review relating to a war bonus "under consideration for W.O. engineering staffs," I feel it my duty to state a similar case, but, being under the "Southern Command," I am one of those unlucky ones still working for a low pre-war wage, and not receiving any war bonus whatever, although I have been waiting for one since 1915, when a war bonus was granted. I have made several applications since that date for it; the answers have been: "It is coming through." The last answer, received a few weeks back, was, "Under consideration." Two years have passed, and they have only got to "under consideration"; will it take another two years before they make up their minds?

We work the whole week through, Sunday included, and get no extra for it, but what we cannot understand is, that some of the staff have received the war bonus since 1915, and others not.

Is it not nearly time we had "fair play"? My fellow workman has received the war bonus since 1915. I have not; for what reason none of us can tell. Cannot someone wake things up?

Married Man.

UNION OF SOUTH AFRICA MUNICIPAL ELECTRICAL UNDERTAKINGS.

By E. POOLE, A.M.I.E.E., Assistant Borough Electrical Engineer, Durban.

(Abstract of paper read before the Engineering Section of the Natal Society for the Advancement of Science and Art, at Durban, on August 28th, 1917.)

A few years ago the municipally-owned electrical undertakings of what is now the Union of South Africa could easily be counted on one's hands, and from a list I compiled in 1904 there were then only seven, viz.: Bloemfontein, Cape Town, Durban, East London, Johannesburg, Ladysmith, and Pietermaritzburg, while there were six towns which were controlled by private companies, viz.: Claremont, Kimberley, King William's Town, Newcastle, Pretoria, and Potchefstroom.

Durban, East London, and Pietermaritzburg were supplying electric tramways as well as lighting, while Cape Town tramways were supplied by a private company, as were also Port Elizabeth and Camps Bay.

To-day there are no fewer than 35 municipalities within the Union operating electrical undertakings, representing a total capital expenditure of about £5,500,000, including expenditure on tramways, with which Durban, East London, Johannesburg, Bloemfontein, Pretoria, and Pietermaritzburg are provided, as well as electric light.

There are seven other municipalities which purchase current in bulk from company undertakings, and generally carry out their own distribution work, a capital expenditure of about £170,000 having been incurred, including the expenditure in connection with the Boksburg and Germiston tramways. Four other municipalities have granted concessions to companies which control the whole of the electric light undertakings, the capital expenditure on which amounts to about £28,000. Other concessions are at Cape Town, Camps Bay, Port Elizabeth, and Kimberley, where there are privately owned electric tramways.

The grand total of units sold last year in all the various undertakings amounts to approximately 84,500,000.

Johannesburg, with over 25 million units, and Durban, with over 20 million units, sell between them slightly more than all the other towns put together. Johannesburg's increase over Durban being practically all taken up in extra tramway units.

Unlike England, electric lighting has practically the monopoly, there being no gas works other than in Johannesburg, Port Elizabeth, Cape Town, and Grahamstown; the former is the only town having both gas and electric municipal works, and the latter the only town with a gas company holding the monopoly.

Johannesburg has the largest output, having sold last year no less than 25,057,534 units, while Ceres has the smallest output, with an estimated sale of 9,000 units. To my mind it is the smaller towns we should encourage; in fact, there are only small towns left now, and their problems need just as much consideration in proportion as do the larger towns.

There are no Board of Trade Rules in South Africa, as in England, though these regulations are in the main observed, but the various Provinces of the Union have certain Acts which the electrical undertakings are subject to.

It is unfortunate that our electrical undertakings have no uniformity of plant, for we find all sorts of boiler pressures, engine and generator speeds, voltages and frequencies, &c. Also, in statistical returns we have no standard for such compilation. Some towns go very fully into these returns in their Mayor's Minutes, whilst others are very brief. In accounts we find all sorts of styles, so much so that it is almost an impossibility to make comparisons between one town and another. It is to be hoped that some day this will be rectified.

If uniformity had been aimed at more in regard to plant, the advantages would be manifold, for situated as we are here, some thousands of miles from the manufacturers, if a breakdown happens, we may find ourselves without the necessary spares, or if we are short of the ordinary run of material we have to wait a long time for it, and it is little use expecting our local suppliers to keep spares, or even hold stocks, of all the varieties of plant in use, seeing there are so many different voltages, sizes, &c., required. On the other hand, there can be very little interchange of plant between one municipality and another, even if one municipality were fortunate enough to have plenty of spares.

The chief source of power is steam, which is likely to be retained for some time to come. Of gas plants, the failure of the Johannesburg plant has no doubt caused a set-back in the adoption of such large plants elsewhere in South Africa, but we find some successful small plants operating. Diesel engines, using crude oil, are running with great success.

In water-power plants, Worcester and Aliwal North are partly dependent, and Cape Town has still a small supplementary water plant, but Ceres, Parijs, and Paarl are the only towns entirely dependent on water. Unfortunately, water power in South Africa is generally out of court on account of its varying supply, for what are at one time raging torrents are merely small trickles at other times.

Coal is worked in all the Provinces of the Union, the largest producing area being the Middleburg district of the Transvaal, where it is of an average value of 12,673 B.TH.U. The other Transvaal producing areas are Boksburg, Springs, and Heidelberg. In the Orange Free State we have the Vereeniging district, where the coal is of an average value of 10,626 B.TH.U.

In Cape Colony the seams worked are in the Molteno, Cyphergat, and Serkstroom districts, but the coal is of poor quality. In Natal there are several districts where coal is worked, both north and south of the Biggarsberg, the average value south of the Berg being 13,079 B.TH.U.

The finest South African coal, however, comes from the Hatting Spruit district, being as high as 14,306 B.TH.U.

Outside the Union, in Rhodesia, we have the Wankie Colliery, where the coal has a value of 13,039 B.TH.U.

Steam pressures are found to vary between 120 and 200 lb. per sq. in., while the price of coal varies from 8s. to as much as 23s. 6d. per short ton, and the pounds of coal used per unit varies from as low as 3.19 to as high as 16 lb. In the larger stations the water tube boiler of the Babcock & Wilcox type is chiefly to be found. The old style of boiler house, with its long range of boilers and one or more tall chimneys, is now becoming a thing of the past.

Turning to the smaller stations, boilers of the loco. type are principally to be seen, and may be looked upon as being best suited for small outputs. They are cheap in first cost, easy to install, very efficient, and can well be left in the hands of an Indian or native to operate.

The storage of coal and handling of coal and ashes has received due attention at the larger stations; the bin at Cape Town has a capacity for 3,620 tons. The class of coal used in some towns where there are mechanical stokers is that known as dross, which at one time was looked on as waste, the price per ton at the pit mouth being from about 1s. to 3s. per ton, as compared with the previously used round coal for hand firing at about 7s. 6d.

Of engines and generators we find quite a large variety, of many sizes; where a few years ago a number of small units were to be seen, these have been superseded by a few large units.

Speeds up to 3,000 R.P.M. are now common in turbines driving alternators; the first geared turbine in South Africa is at the Durban power station, where the speed is geared down from 3,000 to 428 R.P.M. The saving in large turbines is very marked, and we are able to obtain a result as low as 14.3 lb. of steam per unit as against 20 lb. in a reciprocating set. In the smaller steam stations the reciprocating engine of the high-speed vertical type still holds sway.

In the smaller stations atmospheric exhaust is often adopted owing to the lack of a water supply, as well as the necessity of keeping down the capital expenditure, though a saving of from 20 to 25 per cent. can be effected thereby with reciprocating engines. The question of water supply for condensing purposes is one of great importance. Few towns have a natural supply, the general practice being to use water from the town mains, in conjunction with cooling arrangements, though Johannesburg is fortunate in having five bore holes from which a good supply of water is obtained.

Of the coastal towns, only Cape Town and East London have taken advantage of the sea water by building their power stations near the wharves.

The Diesel oil engine, the type in use in this country, is looked upon as the best of its class. They are generally of the four-stroke type, in sizes up to 700 or 1,000 H.P., and vary in speed from 150 to 400 R.P.M.; above this power they are of the two-stroke single-acting type.

In generation we find examples of both direct and alternating current, the latter being three, two, and single-phase at various voltages and frequencies. In the larger towns we find—with only one exception—a mixture of D.C. as well as various phases of A.C. generation, but the smaller towns generally rely on the one source.

The exception in the larger towns is at Bloemfontein, where three-phase only is generated and distributed from sub-stations, while rotary converters in the power station convert the three-phase A.C. into D.C. for the tramway supply.

At Durban generation is D.C. for tramways and motor supply to private consumers, also single-phase as well as three-phase for lighting and power, the three-phase being used for Government bulk supply, large power consumers, the supply to the suburbs of Red Hill and Greenwood Park, and also for supplying rotary converters used to supplement the D.C. supply. It is also transformed down to two-phase, 2,750 volts, through sets of special transformers (Scott-connected), from which single-phase feeders are taken off and balanced between the two phases.

At Port Elizabeth generation is D.C. and three-phase, the latter operating motor converters to supplement the D.C. supply, and also supplying the outlying districts with A.C. single-phase L.T. distribution, as well as three-phase for large power consumers.

At Pietermaritzburg generation is three phase as well as D.C. and single-phase, the three-phase supply being supplemented by a motor-generator and rotary converter from the A.C. single-phase and D.C. supply respectively.

At Johannesburg generation is chiefly by two-phase turbo-alternators, with motor-converters for the D.C. supply for

lighting and tramways in the inner area, but there are also a few reciprocating generator sets for both the A.C. and D.C. supply. The two-phase also supplies the outer area with single-phase distribution for lighting, and D.C. supply through rotary converters in sub-stations for tramways.

At Cape Town generation is D.C. and A.C. two-phase 2,200 volts, with motor-converters from the latter source of supply converting to 440 volts D.C. for the old Cape Town area. The two-phase supply is also transformed up to 11,000 volts, three-phase, for the suburban distribution, and also for the supply to the railway works at Salt River.

In the smaller towns D.C. generation is practically universal. The exceptions are at Paarl, King William's Town, and Harrismith, the former town having made a wise and unique selection in A.C. three-phase at 3,300 volts, while the two latter towns have adopted A.C. single-phase.

The largest generators are in Johannesburg and Cape Town, being 3,000 KW. each. Durban is the only place where boosters are used to compensate for the voltage drop at distant points on the tramway track, while Cape Town uses them for keeping up the pressure on the L.T. lighting network.

Durban and Cape Town are the only large stations where a battery is installed, though in a few of the smaller stations batteries are provided with the object of being able to shut down the running plant during the hours of light load.

The universal practice is to earth at the power station the negative of a D.C. supply to tramways, and also to earth the neutral point in a three-wire supply. In A.C. single-phase working the side to which the outers of the outgoing concentric feeders are connected is always earthed, while in three-phase working with star-wound generators, the neutral point is sometimes earthed through a small resistance, which in the case of Durban is 8 ohms.

The latest type of switchgear as in use at the larger stations is the remote-control oil switch in cubicle form. At Pietermaritzburg there is a separate switchroom just off the engine-room, and at Johannesburg the switchgear is arranged on three floors. At Durban the switchgear is divided, that controlling the generators being mounted on a platform a few feet above the engine-room floor, while the outgoing feeder switchgear is in an adjacent room, where also are installed the boosters, converters, three to two-phase transformers, &c.

In Durban there is installed a special time-signal device which, by throwing a choking coil in the circuit at a time arranged (8 p.m.) lowers the voltage sufficiently for the consumers to observe, and thus their clocks can be adjusted, the time signal being given by the Post and Telegraph Department.

In the smaller stations supplying lighting only, one can hardly avoid the objectionable peak; in the larger stations, however, the introduction of motor load, cooking, tramways, electric vehicle charging, &c., has helped very much to flatten out the peak, and thus improve the load factor, which is highest in Durban at 44.8 per cent.

In connection with "daylight saving," if this is adopted Durban will be affected more than any other town in South Africa, owing to its geographical position, and the fact that approximately solar time is kept. The summer load factor under ordinary conditions works out at 32.39 per cent., but with the introduction of daylight saving it is raised slightly to 32.48 per cent.; 1,260 less units are sold during the 24 hours, representing a saving of two tons of coal for the day, with a loss of revenue of £18 a day.

Distribution.

Generally speaking, the use of bare overhead mains is the common practice in South Africa. Some towns adopt it entirely; others have underground mains as well, but Harrismith and Aliwal North are the only towns where no overhead mains of any sort are used. There is no doubt that the use of overhead mains has in a very great measure helped the progress of electricity supply in South Africa on account of the great saving in first cost, as well as the accessibility to carry out repairs. The prejudice on the score of unsightliness and danger of falling wires is now practically non-existent.

The general practice in the case of feeders both for high and low-tension mains is to lay them underground, but in a few cases extra-high-tension as well as high-tension feeders are run overhead. With distributors, the practice in the larger towns is to lay them underground in the business areas, and overhead in the residential districts, and in the smaller towns they are mostly overhead bare copper (though at Worcester, aluminium wires are partly used), three-wire distribution being generally adopted, but Cape Town in some parts has five-wire distribution, and Paarl and Bloemfontein have four-wire.

In low-tension work the Siemens and the sectional type of steel pole are common practice, varying in height from 20 to 35 ft. in most cases, but on the coast there is an opening for a pole less affected by rust, and in the reinforced concrete pole we have an excellent substitute, which, while rather heavy to handle, has its advantages in life as well as in appearance.

The cross-arms in use are wood, channel iron, and tubular steel. Johannesburg has probably the largest low-tension network of overhead mains, amounting to no less than 191¼ route miles. With overhead mains many arrangements are put forward to dissipate the effects of lightning, which is very severe, especially in the towns of high altitude, and the use of earthed guard wires on the top of the poles has for a long time been looked upon as a safe precaution, in addition to the use of arresters on the lines at frequent points, though, of course, no device will avert a direct stroke. There are, however, one or two towns which have not taken these precautions, and opinion is still very divided on the subject. Apart from the fact of the earthed guard wire being a precaution against lightning, it is also advisable from a safety point of view, in preventing a pole from becoming dangerously charged owing to any of the mains coming in contact with same. The Government regulations provide that cradles or guard wires shall be erected under the mains at railway crossings and certain other places, but with good construction there is little to fear from falling wires, and frequently the precautions taken in this regard, as well as in the case of lightning, are more a source of trouble in themselves than a preventative.

With high-tension work, the bulk of the mains are laid underground, though in Johannesburg, Bloemfontein, Durban, and Cape Town a few of the routes are by overhead wires, Durban having extra-high-tension also for supplying the adjoining suburbs, and in the case of Bloemfontein the overhead H.T. mains are insulated wires. Durban is very fortunately placed in having practically the freedom of the whole of the roads for pole line construction, as the telephones are municipally owned as well as the tramways, the former being the one instance in South Africa, and with this one control many of the taller poles carry electric lighting wires on the top, telephone wires below, and under these the tramway span wires. In regard to the cost of overhead mains against underground mains, there is very little difference in the first cost of a circuit for high-tension work, using the best class of material throughout, but a great saving is effected when an additional circuit is required, as the cost of poles does not then come in for consideration. In low-tension work, however, there is a decided saving in favour of overhead mains, to say nothing of the saving in street-lighting and house-service costs.

Where underground mains are in use, the general practice is to use lead-covered, armoured and served mains laid direct in the ground at a depth of from 2 to 3 ft., but there are a few cases where they are drawn in through pipes or ducts, or laid in a trough filled in solid with bitumen. In Durban a charge of 1s. 9d. per yard of running trench is made by the roads department for reinstating after any excavations. Various dielectrics are in use, such as rubber, fibre, bitumen, and paper, and cables laid over 20 years ago with vulcanised rubber insulation seem as good to-day, as far as the rubber and wires are concerned, as when laid; but rubber cables are out of court on account of the price, and a very excellent type is the paper-insulated cable, which is universal the world over. Where at one time joints were made by screwed fittings in a cast-iron box filled up solid with special compound, the common practice now is to sweat it all up solid and insulate with tapes, after which a lead sleeve is wiped on, and in the hands of a careful plumber-jointer there is no more fear of a joint giving out than the cable itself. Too much attention cannot be given to the matter of joining all the armourings of the cable through and bonding them whenever opportunity offers to any rails or pipes. Faults on underground mains will, however, occur even with the best construction. By adopting a system of ring main and the free use of interconnecting switch pillars, great relief can be afforded, as the fault can then be localised between any two pillars, and at the same time supply can be maintained by the duplicate route that exists.

In extra-high-tension mains Cape Town has about 20 miles laid, with some routes at 11,000 volts, and Johannesburg has the longest routes of both high and low-tension, with 61¼ miles of the former and 143¼ miles of the latter.

(To be continued.)

Electrolytic Iron for Commercial Use.—The Société Le Fer, in France, has succeeded in producing electrolytic iron on so large a scale, in retorts absorbing as high as 20,000 amperes, that the Bouchayer and Viallet Works, at Grenoble, which hold a concession of the Society's patents, have already commenced the manufacture of pipes of large size from electrolytic iron. These are 4 m. long, 100 to 200 mm. in diameter, and 1·5 mm. in thickness (13 ft. long, 3·9 to 7·8 in. in diameter, ·06 in. thick). These tubes are employed for various industrial purposes, such as conduits for water, steam, or compressed air. They have given entire satisfaction in practical use. Such a tube of electrolytic iron is said to possess the same strength as a tube of cast-iron 20 times as thick. The iron obtained by this process is said to be entirely different from ordinary iron, both in aspect and in properties. From the magnetic point of view it is possessed of a very high permeability and a low degree of hysteresis, making it particularly valuable for the manufacture of motors and transformers; from the mechanical point of view it possesses great strength and a considerable degree of extension. The tubes are expected to replace successfully the German tubes of which Mannesmann held a monopoly before the war.—*Scientific American.*

THE ELECTRICAL INDUSTRY AND THE WAR.

On Tuesday last week Mr. J. S. Highfield, M.Inst.C.E., delivered an address, as President of the Association of Supervising Electricians, dealing broadly with the conditions prevailing in the electrical and other trades in this country. He pointed out that the war was but a continuation of the trade war which was previously in active progress, and that, in addition, there had been excessive internal competition, particularly in some branches of the electrical industry; prices had been cut to a degree which compelled the reduction of quality of materials and labour, as well as low wages and inadequate profit. No trade could exist in a healthy state under these conditions; the best men would leave it, credit would be reduced, and capital would be withheld from it. Everybody had worshipped the fetish of cheapness without regard either to quality or to the general good of the community, or to the security of the nation, and, by this carelessness, the foreign suppliers were provided with an easy means of capturing many of our trades. The British customer who bought German wire and German switches before the war helped to build the German navy or weaken the British, because, even when the goods were supplied by the German at cost price or under, a certain amount of money passed to Germany, and at the same time some British were rendered less capable of contributing to the cost of our Navy. The foreigner supplied goods at these low prices only so long as the competition of the home manufacturer continued, the object being to carry on until the British manufacturer went out of business altogether. During this period some advantage accrued to the British purchaser, but as soon as the home manufacturer was driven out of business, the foreigner naturally increased the prices as much as possible, and then the British purchaser enjoyed his advantage no longer.

Unless British manufacturers held a very substantial part of the home market they could not take an active part in foreign trade. Therefore, one of the most important things to be done was to see that, in the future, the laws of this country should be such as to help them to manufacture for and to trade in a secure home market. The average purchaser would have learnt, before the war was over, that he should buy as far as possible articles of British make, and employ men of British birth, but this might not be sufficient, and then it would be for all of them to see that proper steps were taken to make sure that the desired end was accomplished, if necessary, by legislation.

They would agree with him that the capital invested in the electrical business had not earned sufficient profit, owing to the prices having been too low. To reduce prices before profits were obtained was a gamble. Their own particular branch of the industry had suffered from low prices, although he considered that the average standard of work was good; they must in future endeavour to make it a well-paid business, carrying out good work in sufficient volume to enable it to be done at low prices. Competition must be fair, and all the men in any trade should realise that they were working for a common end, and pull together.

There was no way so effective in improving design as the clear realisation of the defects of existing apparatus, and this could only be done by the men in actual daily touch with the difficulties; they could do a great service to the wiring business by collecting information about defects in the existing gear that they used, and by making suggestions as to the remedies they found necessary, and as to permanent improvements. A committee might be formed for this purpose.

Better wages were desirable, using the expression in the sense that the earner could get a better exchange, and with more work done by each man, and more men and women working, the desired result could be secured. This desirable result could be furthered by using standard designs, labour-saving machinery, and better skill in direction; but the one great essential was to secure a large and increasing market for labour, and the things it produced.

In addition to working for themselves, they would have, in the future, to work for all those who in the war had lost the power to keep themselves, and the women and children left by the gallant men who were no more. The sternest efforts were wanted to win the war, and winning the war meant not only conquering the enemy, but preserving a stable State wherein each man could, with his neighbour's assistance, lead a proper life, full of work, and with some comfort. The common credit of the nation had been used in this war with the most marvellous results; the same credit might be required to carry on successfully in peace. But credit must be paid for, or it vanished like a dream, and it was their business to consider how their trade could pay its share.

Electro-Galvanising.—Mr. Sherard Cowper-Coles has now erected at Sunbury-on-Thames one of his latest electro-galvanising plants, which embodies many important improvements and ensures an even homogeneous coating which is amalgamated with the surface of the iron. Mr. Cowper-Coles's process has been largely adopted by the Admiralty and various Government departments, also by several of our Allies.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Generation of Continuous Current by Turbines.

The practice of generating continuous current by the use of turbo-alternators coupled to rotary converters is rapidly extending. One of the numerous installations of this description laid down by the General Electric Co., Ltd., is depicted in the accompanying illustration. This plant is installed in an important engineering works, and comprises a 1,500-kw. "Witton" turbo-alternator running at a speed of 3,000 r.p.m. and generating six-phase alternating current, which is delivered to two 750-kw. "Witton" rotary converters running at 600 r.p.m. and generating continuous current at 460 volts.

The installation has proved completely satisfactory, and has again demonstrated the utility of this method of generating continuous current, which enables the turbine to be run at a speed

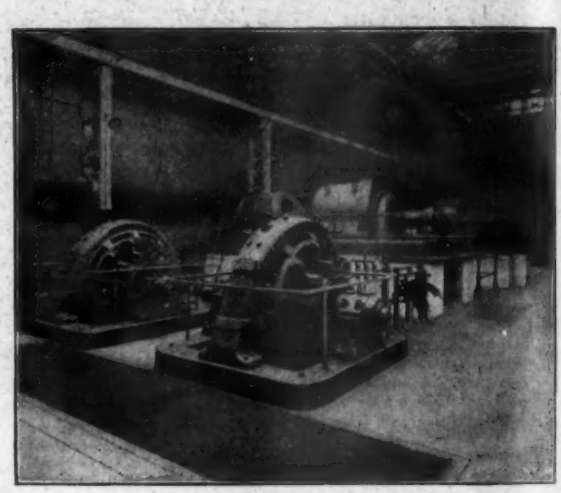


Fig. 1.—1,500-kw. "Witton" Turbo-alternator and Rotary Converters Generating Continuous Current.

at which the highest efficiency is attained, while at the same time the continuous-current commutators on the converters can be designed with a peripheral speed consistent with satisfactory working.

In the background of the illustration a 750-kw. "Witton" continuous-current turbo-generator set is seen, which has now been running for over ten years. This type of machine is now superseded for the generation of continuous current by the combination described.

The complete installation was laid down by the General Electric Co., Ltd., of Witton, Birmingham, and Queen Victoria Street, E.C. 4.

B.T.H. Direct-Current Motors.

A range of d.c. motors of 0·15 to 10 h.p. at pressures up to 600 volts is described in a new list of the British Thomson-Houston Co., Ltd., Rugby; the machines are fitted with commutating poles,

Fig. 2.—B.T.H. Protected Type DQ Motor.

end-shield bearings, ventilating fans, and enclosed terminal boxes, and can be supplied as protected, enclosed ventilated, or drip-proof motors, while the larger sizes can be supplied as pipe-ventilated motors.

Fig. 2 shows the protected type, from which the others differ in

the design of the end-shield. The motors will stand overloads and are capable of shunt speed regulation up to 50 per cent. above normal. They can also be fitted with covers making them "totally enclosed," the rating then being modified. The armature windings are vacuum-impregnated, and are tested with 1,500 volts A.C. after the full-load heat run. The magnet frame is of cast-steel, the laminated poles being removable, with the field coils, without disturbing the armature, and the bearings are provided with oil-ring lubrication.

The Willard Accumulator Plate Separator.

We are able to give a few additional particulars of the new accumulator plate separator which has lately been adopted in the batteries made by the Willard Storage Battery Co., of Cleveland, O., U.S.A., and reference to which was made in a recent issue. Because of the fact that rubber forms an excellent insulating material, many experiments in the direction of using it as a plate separator have been made in the past. Punching holes in the rubber has not, however, proved entirely satisfactory, because if the holes were too small, the electrical resistance was high, while if the holes were large, small particles of the active material were likely to bridge the gap and short-circuit the plates. In the new Willard separator, the same idea is adopted, except that the holes are closed

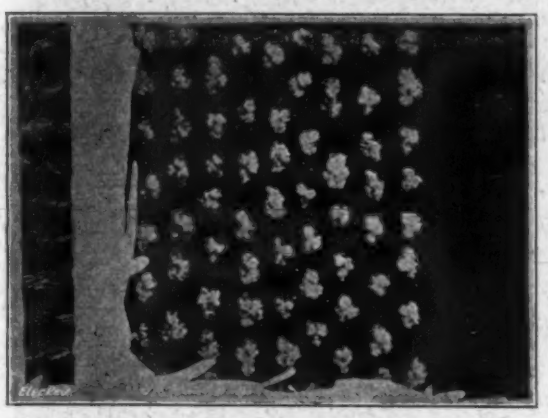


Fig. 3. Photomicrographs of the Willard Separator.

by a very large number of threads which act as wicks. In fact, it is stated that each separator is pierced by no fewer than 196,000 threads, $\frac{1}{16}$ in. long, and of a diameter so small as to be almost invisible to the naked eye. It is stated that the battery solution is drawn through these threads by capillary attraction and offers a free passage to the electric current, while at the same time presenting a solid face to the active material. It is not claimed that the new separator—for the manufacture of which special machines have had to be designed—will render the battery indestructible, or that it will permit neglect by the owner or user; the makers do, however, claim that the new separator tends to increase the capacity of accumulators to stand abuse and to lengthen their useful life.

WAR ITEMS.

Germany's Coal Shortage.—The "Times" states that owing to the dearth of coal Berlin householders are ordered to reduce lighting to an absolute minimum. Also that owing to lack of coal five towns in Bohemia are without electric light, and three without water.

Trading with the Enemy.—The "London Gazette" for September 28th contains a further list of persons and bodies in the following countries with whom trading is prohibited:—Argentina, Chile, Colombia, Netherlands and Netherlands East Indies, Norway, Peru, Spain, Sweden; also a number of variations in previous lists.

The One-Man Business.—Sir Auckland Geddes, Minister of National Service, last week received a deputation from the National Association of Business Men. A considerate hearing was given to the statement advanced concerning the calling-up for military service of the proprietors of "one-man businesses," and a further conference takes place later.

Exemption Applications.—At Southwark, Coun. T. E. Hewitt, a member of the Tribunal, who carries on business as an electrical engineer in Southwark Bridge Road, applied for the exemption of three sheet-metal workers, aged respectively 28, 27, and 23 years, and for a fitter and mechanic, 33, all passed for general service. He said the cases had been adjourned in order that he might obtain certificates under the Protected Trades Schedule. After some delay, an officer from the Department visited his works, and expressed his satisfaction, but stated they would be prepared to grant the certificates provided that the men would join as munition volunteers under the substitution scheme. If they did that the Government would have the first claim on his men, and therefore he did not know how he should stand, as he would have to prove that the work on which they were engaged, although not for the Government, was of national importance. Mechanics and fitters were so badly wanted by the Government that there would be very little chance for him to keep them. He therefore came before the Tribunal for protection. He was prepared to release the two younger sheet-metal workers, provided they would permit him to retain the other two men. The remaining sheet-metal worker had been with him since he was a boy, and he would be the only man left in the department, where before the war he had 17 men. The fitter was the only one he would have left. He must at least have these two men to carry on. The two sheet-metal workers were instructed to join up by November 1st, and the other sheet-metal worker and the fitter were granted three months' exemption each.

At Bermondsey, the Tribunal unanimously adopted a resolution that, in view of the large number of men in low medical categories now appealing for exemption, they considered it would eliminate considerable hardship and increase the efficiency of the fighting forces if Class A men (general service), who were unmarried, between 18 and 25 years of age, were taken for military service in large numbers from munition works, and they urged the Government to take action in this direction.

At Batley Tribunal last week, H. Jagger, electrician, aged 37, married, whose medical examination had been postponed, submitted a communication from a Sub-Committee of the Ministry of Munitions, in reply to his application for a protection card under the list of protected occupations, stating that arrangements had been made for the issue of a certificate to the applicant. The Tribunal granted temporary exemption to November 1st.

Exemption was claimed at Windsor by W. J. Hetherington (38, Class A), electrician with Messrs. Martin & Co., on the ground that he was engaged on work of national importance. The Military Representative said that there was a very great need in the Army for electricians, and a man with appellant's knowledge was valuable. The appeal was refused, with a month's grace.

A Crawley firm applied to the Horsham Rural Tribunal for exemption for an electrician (31, B 1), the only practical man left, and who had been medically rejected for the Volunteers on account of deafness. Three months were granted, with a fresh medical examination in the interval.

At Tunbridge Wells, A. T. Spurrell (C 1) and A. E. Hills (B 1), were appealed for by Mr. E. Powell, electrical engineer. The men are wiremen, and Mr. Powell said that they were engaged on work of national importance, and that they were three weeks' behind in their jobbing work. The Tribunal decided to have a report prepared with regard to all the electricians in the town, and the appeals were respited for this purpose.

Before the Wilts. Appeal Court, exemption was claimed for L. Horne (28, C 2), electrician at Chute Standen, Andover. The appeal was refused.

At Bexley, the manager of the U.D.C. tramways (Mr. H. P. Stokes) appealed for conditional exemption of four motormen, one a discharged sailor. It was stated that the Council had taken over the working of the Dartford tramways, which meant extra work, while an efficient service for munition workers was necessary. Three of the men were given conditional exemption, and the case of the other, a Class A man, was adjourned.

At Hastings, the Tramway Co. appealed for the retention of a motorman (24, C 3). Three months were granted, the man to join the Red Cross.

At Oxford, the Military applied for the withdrawal of a certificate of conditional exemption granted on March 13th, 1916, to H. G. Barrett (31, Class A), lately engaged with Messrs. Hill, Upton & Co., electrical engineers. When he left the firm his badge was taken away, and he was now ordered to join up in a month.

East Kent Appeal Court has granted exemption until November 6th to G. H. Hawkins, electrician at Denton Court Estate.

Guildford Tribunal has given a final month to W. H. Dann (33, C 1), electrician at the County and Borough Halls.

New Zealand.—H.M. Trade Commissioner in New Zealand (Mr. R. W. Dalton) writes, under date July 25th, that owing to a recent labour dispute at Wellington, the gas supply for all purposes has been restricted, and this has led to a large increase of orders for the installation of electric lighting, heating, cooking, &c., appliances. Householders and business people turned to electricity as a substitute or stand-by for their various requirements; and electrical engineers and suppliers of electrical goods experienced a rush of business. According to the local Press, the sale of electric cookers, heaters, kettles, smoothing irons, &c., constituted a record, and, further supplies of such articles being difficult to obtain, stocks are now low. For some time past the only market open to New Zealand buyers for the purchase of electrical goods has been the United States, but now even that source is becoming uncertain.—*Board of Trade Journal.*

DAMAGES ON FAILURE TO COMPLETE A CONTRACT.

[By our Legal Contributor.]

There is little doubt that the exigencies of the times have given rise to a large number of cases in which those who sell or buy machinery have been compelled for one reason or another to commit breaches of contract.

A manufacturer may have given a large order for electrical machinery before or in the early days of the war. Suddenly, through the intervention of the Ministry of Munitions, the normal course of business at the factory of the buyer is entirely altered. He is unable, or unwilling, to take delivery. Assuming that the prospect of matters being interfered with by the Government was not provided for in the contract, what are the rights of the parties?

With a view to assisting those who are in the position of persons whose contracts have been broken, it is proposed to examine the decision in a case heard in the Court of Appeal. It involved consideration of the apparently simple problem: What is the measure of damages when a trader fails to take delivery of machinery which he has ordered? As a general rule, of course, the failure to take delivery is due to "failure" in the larger sense; and if that is the case, the trader must fain be content with whatever dividend may be paid in the bankruptcy.

Let us assume the occurrence of a case in which the property in the goods has not passed to the buyer. If the property has passed the remedy is obvious; the seller can sue for the whole amount due without deduction of any kind. But if there has been a mere failure to take delivery, the damages must be assessed on certain well-recognised principles. If there is a ready market for the goods, little difficulty arises. Suppose a man had undertaken to deliver a machine on March 1st for £100, and the purchaser were to announce on February 25th that he cannot take delivery. If the buyer was able to find another person willing to buy on March 1st for £100, it is clear that the seller would suffer no loss, and no damages would be awarded to him by the Court. But if he were only able to sell for £95, his damage would be £5, and so on. Now, take the case where there is no available market, and the goods are thrown on the seller's hands. In that case the damage which he sustains might be very much more severe. Indeed, it is possible to conceive a case where, in the event of a purchaser failing to accept delivery of a piece of machinery of a highly special type, its only value to the seller when thrown on his hands would be the value of old iron.

A case in point is in *re* Vic Mill, Ltd. (1913), 1 Ch. 465. The Vic Co. had ordered certain machines to be made by Messrs. Arundel & Co., a firm of engineers. The order having been given, the company went into voluntary liquidation, and were unable to accept delivery. The engineers, as creditors, put in a claim in the liquidation for the profit which they would have made had they been allowed to deliver. Upon this basis, they claimed £167 13s. 6d. As the liquidator rejected their claim, the registrar of the winding-up court was called upon to inquire what was due. As the various machines embodied in the order were on a slightly different footing, it is necessary to inquire what they were. They were in two classes. Class I consisted of four quick-traverse winding frames, which had been completed before the date of the winding up. These were retained by the engineers, and were then somewhat altered and resold to other customers at a price less than the contract price. Class II comprised machines which would have been wholly or partially manufactured by the engineers, on which they had done no work, but for some of which they had purchased subordinate parts ready made, which they afterwards used in fulfilling other orders. The loss of profit claimed on Class I amounted to £162 19s., and on Class II. to, roughly, £1,000. The engineers claimed the whole of this. As regards the winding frames, the registrar found that they had been altered at a cost of £5, and resold at a price which was £23 less than the amount the company had agreed to pay. He therefore awarded £28. As regards the machines in Class II, they would be for the most part built up out of stock. There was no evidence that the engineer's works had been wholly or partially stopped in consequence of their not manufacturing these machines, or that the orders on which they were engaged were less remunerative than those under consideration. The registrar held that though prospective profits must be taken into account, it could not have been as much as £1,000, and awarded £250. The judge to whom the registrar's finding was referred over-ruled him, and declared that the engineers were entitled to the loss of profit as they had themselves estimated it, and the Court of Appeal confirmed the judge's decision.

The judgment of Lord Justice Hamilton in the Court of Appeal is very instructive. He said, as to the goods in Class I:—"The registrar thought he had evidence to the effect that the loss was only £250, but he had none. Consequently his assessment of £250, though not in itself surprising as a matter of business, was one unsupported by any evidence before him. It is true that there is no evidence that the creditor's works were wholly or partially stopped in consequence of their not manufacturing these machines. If that had been so there might have been a claim for some proportion of the overhead charges attributable to the period when the works were at a standstill, when charges were running on, and nothing was being made against them, because the appellants, the buyers, would not perform their contract. It is true that he found that there was no evidence that the orders on which the works were employed were of a less remunerative nature than the orders in respect of which the claim for damages was made. Had that been so, it might have been an alternative means of measuring the damages—that, whereas during such and such a time they would have been working at a profit of 35 per cent. on their turnover, they were obliged to work for somebody else, and could get no more than a profit of 30 per cent. The affidavits fairly read show that the claimants' works were sufficiently large, and their equipment sufficiently ample, to enable them to perform this contract in addition to all the others that they did perform. . . . As the evidence stands, there was a *primâ facie* case that the makers could have made this profit as well as the profits on all the other contracts they had. There was not only no evidence to rebut that, but no suggestion to the contrary was made in cross-examination. It is tolerably clear that the point really fought was whether or not there was an available market in which the goods might have been sold—a point which disappears by the admission that there was no such available market."

Dealing with the winding frames, on which the engineers claimed £162 19s. for loss of profit, his Lordship pointed out that there the duty of the engineers in the circumstances was to act reasonably. There was no available market. If the goods had been broken up, or sold by auction for what they would fetch, the consequences to the buyers would have been worse than they were. He then proceeded:—"It so happened that, after the repudiation by the Vic Mill, another customer of the makers was prepared to place an order with the engineers for frames of that kind, and somewhat of those dimensions. They might have taken that order, fulfilled it, made their profit on it, and dealt with the frames left on their hands in any reasonable way they chose. They did, in fact, at a small cost, adapt the frames on their hands, and with them fulfilled the order of this other customer, and so made their profit on his contract. To that extent the buyers in the present case got the benefit of the accident that another customer came forward. That was a reasonable mode of mitigating the damages, but it by no means follows that the damages are confined to the cost, a trivial one, of adapting the machines to the needs of the second customer, and the loss on re-sale to him, which was only £23, making £28 in all. The fallacy of that is in supposing that the second customer was a substituted customer, and that, had all gone well, the makers would not have had both customers' orders, and both profits. In fact, they did, acting reasonably, and, I think, very likely more than reasonably in the interests of the Vic Mill, content themselves with earning the profit on the second contract at the cost of adapting the machines, which has been taken at £5; but they are still losers of the profit which they would have made on the Vic Mill contract, because they could, if they had been minded, have performed both contracts, and have made profits on both the contracts but for the breach by the Vic Mill of their contract."

In the result, the Court of Appeal held that the engineers were entitled to the full amount claimed.

A discussion of the converse case may also be instructive. Suppose that a manufacturer has undertaken to deliver machinery, and, owing to reasons which he cannot control, but for which the law holds him responsible, he supplies an inferior article. What is the measure of the damages which he must pay?

The case of the British Westinghouse Electric and Manufacturing Co., Ltd. *v.* Underground Electric Railways Co., which was decided by the House of Lords in 1912, involved a discussion as to the measure of damages where the manufacturer has failed to provide a satisfactory machine. The material facts may be very briefly stated. In 1902 the British Westinghouse Co. (who may be conveniently referred to as "the claimants") contracted to supply certain steam turbines and turbo-alternators to the Underground Electric Railways Co. (hereinafter called the respondents) for £250,000. Payments were to be made by instalments from time to time. Eight steam turbines and eight motor generators were delivered from 1904 to 1906, the respondents paying £159,439 3s. 2d. on account of purchase price. In spite of certain agreed reductions, a large balance of the purchase price was still outstanding when the proceedings presently referred to were commenced. All the machines proved to be defective in design and efficiency, and failed to comply with the contract and specifications, but the respondents, while reserving their rights, continued to use them for supplying power to their railways. In 1907 the claimants, with the consent of the respondents, who still reserved their rights, removed and experimented with one of the machines, with a view to seeing whether it could be put in order, but the experiments failed. Finally, the respondents made arrangements to substitute for the claimant's turbines "Parsons machines," of different design and manufacture.

The claimants having sought to recover the unpaid balance of the purchase price, the matter was referred to arbitration. At the hearing before the Hon. Alfred Lyttelton, the respondents counter-claimed damages, and alleged that, as part of the damages, they were entitled to the sums expended on the Parsons machines, as the purchase of those machines "mitigated or prevented the loss and damage which would have been recoverable from the claimants if the respondents had continued to use the claimant's defective machines in the future." The claimants, on the contrary, alleged that as the commercial life of their machines had expired at the date of the purchase of the Parsons machines, no further damages were recoverable from them after the date when the Parsons machines were procured. The arbitrator stated a special case for the opinion of the Court upon these questions. The Lord Chief Justice, after reviewing the facts above set forth, said: "*Primâ facie*, it seems to me the questions to be considered as to the measure of damages are: (1) What would be the natural life of a properly constructed machine; and (2) what would be the damages for having to work the defective Westinghouse machines. If the respondents had not put in the Parsons machines, the measure of damages would have been much larger. When a man is relying on breach of contract, he must do what is reasonable not to make the damages greater than they would otherwise be. Here the cost of the Parsons machines is a matter which the arbitrator must take into consideration. It would not be right to adopt the contention that because Parsons machines had so much improved in 1908, 1909, and 1910, the Westinghouse machines had come to an end of their commercial life."

What he found is stated by Lord Haldane in his judgment in the House of Lords (1912, A. C., at p. 688), where he says: —"The arbitrator appears to me to have found that the effect of the superiority of the Parsons machines and of their efficiency in reducing working expenses was, in point of fact, such that all loss was extinguished, and that actually the respondents made a profit by the course they took. They were doubtless not bound to purchase machines of a greater kilowatt power than those originally contracted for, but they, in fact, took the wise course in the circumstances of doing so, with pecuniary advantage to themselves. They have, moreover, used the appellant's machines for several years, and had recovered compensation for the loss incurred by reason of these machines not being, during these years, up to the standard required by the contract. After that period, the arbitrator found that it was reasonable and prudent to take the course they actually did in purchasing the more powerful machines, and that all the remaining loss and damages was thereby wiped out."

This case affords a striking illustration of the statement (which so often shocks the non-legal mind) that law is the embodiment of common sense. The railway company did what must, in practice, have been their imperative duty. The machines having failed, they were bound to keep their trains running. Instead of tinkering with old plant, they bought of the very best, with the result that their position both present and future was vastly improved. As the damages in the long run were thus reduced, they were not allowed to recover them from the Westinghouse Co. The case serves to remind one of that principle of the law of contract which says that a man whose contract is broken must not sit down under his loss. For instance, in the case of a sale of goods where the buyer refuses to take delivery, the seller is bound in all cases to take any reasonable steps which are open to him to reduce his loss, and if it is shown that upon the occurrence of the breach the seller might have gone into the market and sold to better advantage than he could have done by waiting until the contract date for delivery, his damages may, it seems, be reduced accordingly.

BUSINESS NOTES.

Book Notices.—"The Housing Question as Affected by Recent Legislation." Reasons for Repeal of Part I of the Finance (1909-10) Act, 1910. London: The Land Union. Price 1s.

"Electrical Measurements." By F. A. Laws. London: Hill Publishing Co. Price 21s. net.

"Principles and Practice of Electrical Engineering." By A. Gray. London: Hill Publishing Co. Price 12s. 6d. net.

Bankruptcy Proceedings.—F. Brown, electrician (formerly a partner in Hugh Bros. & Brown), Llanelly. Trustee released September 21st.

Liquidations.—Naylor Battery Co., Ltd.—A meeting is called for October 31st to hear an account of the winding up from the liquidator, Mr. H. Everett.

Alfred Herbert (France), Ltd.—A meeting is to be held at Coventry on November 8th to hear an account of the winding up from the liquidator, Mr. D. M. Gimson.

M. & G. Truck & Engineering Co., Ltd.—A meeting is called for November 13th, at 12½—127, Minories, London, E.C., to hear an account of the winding up from the liquidator.

Catalogues and Lists.—Messrs. Boving & Co., Ltd., 56, Kingsway, London, W.C. 2.—New pump catalogue of 52 pages, containing particulars of the general design and types of their pumps. Excellent half-tone pictures accompany the descriptions of low-pressure, medium-pressure, and high-pressure pumps, also medium-pressure pumps for hydraulic mining, and stationary and sinking vertical pumps. The firm has made extensive arrangements for testing in the presence of clients. We understand that at the present time the total output of the driving motors for the firm's high-pressure multi-stage turbine pumps is above 15,000 h.p.

Messrs. Pass & Seymour, Inc., Solway, New York.—80-page illustrated and priced catalogue of their handy electric wiring devices.

Messrs. Peckham, Ducamp & Co., 90, Charing Cross Road, London, W.C.—Eight-page illustrated price list of Osram lamps of various types, &c., showing advanced prices for a number of lines.

Sterling Football.—On Saturday last, on the grounds of the Sterling Athletic and Social Club at Dagenham, Essex, football matches were played on behalf of the St. Dunstan's Hostel. In the Ladies' Match, "Sterling *v.* Brocks," the Misses Joy and Crystal Burney "kicked off" at 2 p.m., and at 3.30 "Sterling *v.* Clarence" (the East and South-East London Munition Workers' Football League Match) was played. In the first match "Sterling" scored 4 goals and Brocks 0, and in the second the scoring was "Sterling" 4 and Clarence 2. Mr. Guy Burney, the managing director of the Sterling Telephone and Electric Co., Ltd., has been elected a vice-president of the East and South-East London Munition Workers' Football League.

LIGHTING AND POWER NOTES.

Aberdeen.—In his annual report, Mr. Bell, the city electrical engineer, refers to the considerable increase in the industrial use of electricity in the area, and mentions that an electric steel furnace will shortly be in use in the city. In three years the department has handled a 78 per cent. increase in motor h.p. connected, and the power units sold last year (9,250,000) represent a 97 per cent. increase on the previous year, some 14,000 h.p. of motors being supplied. The lack of railway connection for coal supply, which was planned when the works were laid out, has been acutely felt, and it is noted that about 15s. 3d. in the £ in works costs is due to coal. It is interesting to note that the 14,000 h.p. of motors now supplied represents about 42½ per cent. of the estimated power requirements of the present area of supply. The local shipyards are now considerable power users, and about 1,405 electrical utensils for heating and cooking were hired out by the department. It was found necessary to extend the buildings for a new 5,000-kw. turbine set, and new substations have been provided in York Place and Torry. It is noted that the 3,000-kw. turbine set, since it was installed in 1913, has generated 44,378,000 units out of the total of 50,914,000 units generated in the station; a 500-kw. converter has been delivered for the York Place sub-station, and a 350-h.p. electrically-driven pump is being erected at the generating station. The plant capacity of the generating station is 7,760 kw., and the maximum load was 6,162 kw., the load factor being 26 per cent. The year's working resulted in a small deficit (£345); the charges were, however, reduced by 5 per cent. on the previous year, and a serious increase in working costs was met. The reserve fund stands at £39,304.

Bacup.—Price Increase.—The Corporation electricity department announces that, in consequence of the increase in the price of coal and other charges, the charges for current supplied will be increased from January 1st. For lighting the advance will be 10 per cent. and for power and heating 15 per cent. Consumers who have a coal clause in their agreements will not be affected.

Blackpool.—Vehicle Battery Charging.—The Electricity Committee is considering the report of the engineer (Mr. C. Furness) on the desirability of installing a motor-generator and switchgear at the electricity works to meet the forthcoming demand for charging electrical vehicles.

The output of electricity for July and August reached 949,464 units, an increase of 21,918; and for the year to the end of August the increase was 199,515 units.

Bolton.—Proposed Loan.—The Electricity Committee has approved a report of the electrical engineer as to the proposed plant extensions at the Back-o'-th'-Bank generating station, and has decided to request the Finance Committee to make application to the L.G.B. for sanction to borrow £60,000 for carrying out the work. The extensions have been rendered necessary owing to the increased demand for electrical power.

Bournemouth.—Price Increase.—After conference with the Bournemouth and Poole Electricity Supply Co. as to the revision of the rates chargeable for the supply to the Corporation, an increase of 22½ per cent. has been recommended.

Bradford.—Price Revision.—The Electricity Committee has now adopted a resolution under which, in addition to other revisions, a 10 per cent. increase will apply to the 4d. flat rate consumers. The recommendations, as now to be submitted to the Council, are:—Power consumers having maximum demands of under 5 kw. and power consumers on the restricted hour rate shall pay an additional amount in accordance with the price of coal on the same basis as power consumers having maximum demands in excess of 5 kw. (At present, this means an addition of 20 per cent.) The accounts of all other classes of consumers which are not subject to adjustment in accordance with the price of coa

(with the exception of the tramways department) shall be increased by 10 per cent. For heating and cooking purposes current shall be supplied at a flat rate of ½d. per unit, plus 10 per cent. to consumers who are already taking supplies of electricity for other purposes at the premises for which the supplies for heating and cooking are required.

Castlerea (Co. Roscommon).—E.L. Proposals.—A meeting of residents has formed a Committee to take steps for the introduction of public electric lighting. The cost is estimated at £2,000.

Chatham.—Price Increase.—The Kent Electric Power Co. announces that the price of electricity will, as from October 1st, be increased to 6d. per unit for lighting, and 1½d. per unit for power; to £1 2s. 6d. per quarter for radiators, and special rates by 10 per cent., subject to the existing advance of 33⅓ per cent.

China.—According to an American Commerce Report, the city of Amoy, the island of Kulangsu, Chioh-be, Changchow, and Chuanchow are all equipped, or being equipped, for electric supply. The Amoy Electric Light and Power Co., a Chinese concern, installed two 100-kw. turbine plants and two water-tube boilers, with a three-phase, 60-cycle, 2,300-volt transmission and 110-volt house service by means of transformers near customers' premises. In 1915 a 300-kw. turbine set was added, with two additional boilers. A total of 16,000 16-c.p. equivalent lamps is supplied and 300 fans are on the circuits, as well as 400 street lamps of 16 c.p. size, a number which is to be increased to 600 in the near future.

On Kulangsu Island, a British concern runs a 75-kw., 220-volt a.c. plant, which is, however, overloaded, and a Japanese company is understood to be seeking to put in a plant.

At Changchow a Chinese company, the Chagma Electric Light and Power Co., has been organised to put in 50-kw. and 30-kw. gas-engine driven sets; the supply will be at 440-220 volts, direct current. At Chioh-be the plant consists of two 37-kw. generators, to supply at 220 volts, 3,700 16-c.p. lamps; Chuanchow has a 75-kw. gas-driven set, supplying at 110 volts, direct current, some 3,000 lamps, and it is understood a 150-kw. generater is to be added to the equipment, which is all Japanese.

Other cities in the Amoy district and Fukien province are discussing similar plants, for which the Japanese, who have adopted the extremely liberal credit system of the Germans, are strong competitors.

Continental.—Russia.—It is reported that the employés of the Kharkov E.L. Co. recently arrested the directors and managers of that concern, having decided to imprison them until higher wages were granted.

Darwen.—The borough electrical engineer, town clerk, and Councillor Thornley have been appointed to represent the Council at any meetings held in connection with the suggested inter-connection of the various electrical undertakings in East Lancashire.

Dover.—The installation of prepayment meters is to be discontinued, as the supply with them in face of the high price of meters does not give a profitable return.

East Ham.—Year's Working.—For the year ending March 31st last, the gross profit on the electricity undertaking was £4,667, against £6,266 in the preceding 12 months. The decrease is represented by £1,896 increase in expenditure, less £297 increase in income. After paying interest on loans, &c., there was a deficiency of £244, as compared with a profit on the previous year of £1,902. The deficiency at the close of the year, including the deficit brought forward from previous years, and allowing for the balance of depreciation of renewals fund, was £3,606.

Epsom.—Tar Oil.—On the recommendation of the acting electrical engineer, the U.D.C. has decided to convert a Diesel engine for burning tar oil, which can be obtained at £5 14s. per ton, against from £10 14s. to £17 11s. per ton. This will save £1,000 a year.

Halifax.—Wages.—The Corporation employés in the electricity, gas, highways and other departments, who are at present in receipt of wages 9s. a week higher than pre-war rates, have put in an application for payment which will bring them to 15s. a week above pre-war rates, and also ask that, in the event of any further increase of wages being conceded to the engineering industry, the same wages shall be given to the Corporation employés. The Finance Committee recommends that the application be declined, as the question of wages was referred to, and decided by the Committee on Production, last month.

Haslingden.—The electricity department made a loss of £298 during the last financial year, instead of the estimated profit of £200.

Ilford.—Loan Application.—Application is to be made to the Treasury for a loan of £5,792, the first repayment instalment falling due one year after the termination of the war. The General Electric Co., Ltd., whose tender has been accepted for two 250-kw. rotary converters, insisted on the insertion of a clause in the contract providing for the adjustment of the amount in the event of the manufacturing cost being increased as a result of direct instructions from the Government. The clerk was directed to communicate with the L.G.B. on the matter, intimating that should such an event arise, the Council will anticipate the Treasury reimbursing the Council the extra cost so incurred.

India.—According to *Capital* (Calcutta), of August 3rd, the disappointing quality and quantity of supplies of coal in the North and West of British India has caused consideration to be given to the possibilities of using hydro-electric power as a substitute in industries and undertakings. At Bombay motive power is obtained from the Western Ghats, and in the Punjab it is proposed to obtain water power from the canals. The Bombay undertaking already provides the mills of Bombay with about 40,000 electric h.p. The undertaking is being extended, and is expected to supply all the power required by the Bombay mills, tramways, and Port Trust railway, as well as to provide for the lighting of the city.

The hydro-electric plant at Amritsar, which has been set up recently by the Punjab Irrigation Department, is a similar project, but on a much smaller scale. At present the power is made use of to irrigate fields for agriculture, and to drive machinery in one of the workshops of the Irrigation Department. It is expected that this irrigation from wells will reduce at the same time the subsoil moisture, and so make the city less malarious.

Not only is it probable that, in regions where coal is scarce in British India, hydro-electric power will supplant steam to a large extent in the conduct of industry, but, if the price of Indian coal continues to rise, as is expected, it is also likely that electricity will be generated from coal on a much larger scale than hitherto in all the large towns of India, and utilised for public and domestic services as well as for industries.—*Board of Trade Journal.*

Kirkheaton.—Provisional Order.—Having received notices from the Huddersfield Corporation and the Electrical Distribution of Yorkshire, Ltd., of their intention to apply for a provisional order authorising them to supply electricity within the urban district, the U.D.C. has decided to invite representatives to meet the Council to discuss the matter.

London.—Hackney.—Year's Working.—The report of the Corporation electricity undertaking for the year ended March last shows a total sale of 15,302,372 units, or nearly 69 per cent. increase on the previous year; this large increase was due mainly to power supply, for which some 12½ million units were sold; bulk supply to Poplar also accounted for 748,000 units, but in other directions there was a falling off. Altogether 18 million units were generated, and about 35,000 purchased from Poplar under the interconnection arrangement. The total revenue for the year was £88,050; the total expenditure, £50,478; and the gross balance £37,572, as compared with £24,252 in the previous year. Loan charges amounted to £30,032, and there was a surplus of £5,290 as compared with a deficiency (the first recorded on a complete year) of £8,265 on the previous year. The reserve fund at March 31st amounted to £25,340, after charging thereto the loss, £4,774, in respect of a breakdown to a 600-kw. set.

It is remarked that the large scheme of extensions was completed early in the year, and the effect of the efficient plant is shown in the cost of energy; working and management cost amounts to ·75d. per unit, as against ·84d. in the previous year, while the all-in cost, 1·23d. per unit, is the lowest yet recorded. The decreased average cost is, of course, also due to the increased power supply, some 1,494 motors of 12,370 h.p. being connected, as against 1,381 motors of 8,770 h.p. in 1915-16. Roughly 16 million of the total units generated were a.c.; the maximum load was 7,951 kw. and the load factor 22 per cent.

Bethnal Green.—The B.C. has received sanction from the L.C.C. to the borrowing of a sum of £1,000 for the provision of further house services in connection with the electricity undertaking on the usual condition.

The B.C. has been recommended to add 33⅓ per cent. to all consumers' accounts in respect of electrical energy supplied from October 1st.

Manchester.—Proposed Loan.—The City Council is being recommended to apply to the L.G.B. for sanction to borrow £20,000 for additional electricity mains, due to the demands of consumers engaged on special work.

Preston.—The National Electric Supply Co. has notified consumers that in future the minimum consumption of current chargeable per quarter is to be 25 units.

Rathmines.—Year's Working.—The year's working of the Council's electricity undertaking for the year ended March 31st last shows a total revenue of £15,762, a total expenditure of £10,003, and a gross profit of £5,759. Interest and sinking fund charges amounted to £7,678, leaving a deficit on the year's working of £1,919, which with £1,157, the debit balance brought forward from the previous year, makes a total deficit of £3,076.

Stalybridge.—Coal Clause.—The Joint Electricity Board has decided that the coal clause for power supply shall be raised from ·15d. to ·2d. from January 1st next.

Stoke-on-Trent.—Linking-up.—In connection with the proposed linking-up of Stoke, Newcastle, and Leek for electricity supply purposes, the Stoke-on-Trent Electricity Supply Committee has authorised the engineer to prepare a scheme, jointly with the engineer of Newcastle-under-Lyme, upon that authority confirming the conclusions arrived at by the respective chairmen and vice-chairmen.

Templemore (Co. Tipperary).—Proposed E.L.—At a meeting of the Urban Council, Mr. McDonnell gave notice to move that a public electric lighting scheme be adopted.

Todmorden.—Suggested Bulk Supply.—At the last meeting of the T.C., it was reported in connection with the Council's application to the L.G.B. for sanction to borrow £10,000 for extensions at the electricity works, that the Ministry of Munitions had replied suggesting linking-up with a neighbouring power station.

Walthamstow.—The Finance Committee of the U.D.C. recommends that the recommendation of the Electricity Supply and Lighting Committee be amended so that the charges for current supplied for public and private lighting be increased by a further 13⅓ per cent., making 33⅓ per cent. in all, and for power and heating by a further 15 per cent., making 40 per cent. in all.

It is proposed that prepayment consumers be charged an equivalent of a further 5 per cent. upon the sum taken from the meter. The electrical engineer is to enter into negotiation with those consumers who have period contracts, with a view to their paying an increased price for energy without prejudice to the terms of their contracts.

Wharfedale.—Mr. Woodhouse, engineer to the Electrical Distribution of Yorkshire, Ltd., waited upon the Guiseley District Council, last week, in reference to the company's proposed application for a Provisional Order; he said arrangements had already been come to with Rawdon and Otley, and the company were now approaching the Burley-in-Wharfedale Council and the Wharfedale Rural Council, the latter in respect of Menston. Mr. Woodhouse stated that the conditions had so greatly changed since the time of the agreement with Otley that he could not give an undertaking as regards the terms to Guiseley without consulting his directors.

TRAMWAY AND RAILWAY NOTES.

Australia.—The N.S.W. Government, after consultation with the Railway Commissioners, has decided to increase the fares on the Government tramways; whether this will be done by shortening the length of the sections, or by raising the fares on those already in existence, has not been decided. The latter is considered the most probable, as the Commissioners recognise that businesses have grown up around long recognised tramway sections, which they would be sorry to disturb.—*Sydney Evening News.*

Blackpool.—On the recommendation of the general manager (Mr. C. Furness) the Tramways Committee has authorised the provision of new cross-overs from west to east on the tramway immediately opposite the North Pier. The work is to be proceeded with during the coming winter.

The Tramways Committee has approved a scheme for the doubling of the track between the Hippodrome and Abingdon Street, including the erection of an ornamental shelter at the junction of Abingdon Street and Church Street.

The Tramways Committee has also agreed to the erection of a combined tramway shelter and bureau, with clock tower, opposite Foxhall Square.

Doncaster.—Cheap Tickets Abolished.—The Corporation has decided to abolish all workmen's dinner tickets, coupons, and other cheap return tickets on the tramways, owing to increased working expenses, higher wages, and cost of material.

East Ham.—Year's Working.—The gross profit of the Corporation tramway undertaking for the year ended from March 31st last was £4,493, which showed a decrease on the previous 12 months of £6,094, made up by £2,774 decrease in income, plus £3,320 increase in expenditure. At the close of the year, after charging interest and repayment of loans, there remained a deficiency of £2,395.

Haslingden.—Year's Working.—There was a profit of £495 on the working of the tramway undertaking for the past financial year, after paying £308 to the Accrington Corporation in view of the latter's deficit.

Hebden Bridge.—A conference is to be held between representatives of the Halifax Corporation, the Todmorden Corporation and R.D.C., and the Hebden Bridge U.D.C. to consider the proposal to join up the Halifax tramways with the Todmorden Corporation motor-buses.

Hove.—The Board of Trade has extended to August, 1918, the time under the Corporation Act for the completion of overhead equipment and other apparatus for working trolley vehicles on certain routes.

Ilford.—The tramway manager having been appointed on a Sub-Committee of the Municipal Tramways Association to consider the standardisation of overhead equipment, informed the Tramways Committee of the Council that he was the only member of the Sub-Committee in the South of England, and the meetings would probably be held in Yorkshire; permission to attend these meetings was given.

Lancashire.—Tramway Wages Award.—The award of the Committee on Production in last week's arbitration between 19 Lancashire and Cheshire tramway undertakings and their employés has been received during the week end, and the result is another substantial increase of war wages for the 17,000 to 20,000 tramway workers affected, involving a big extra charge upon the local undertakings. The whole of the workers, male and female, over 18 years of age, will receive an advance of 3s. for a six days' week, and those under 18 obtain 1s. 6d. The total war advances for a six days' week is now 12s. for men, 9s. for women, 5s. 6d. for boys under 18, and 4s. 6d. for girls under 18. The award makes the bonus payable for overtime as well as for the ordinary working wages, as owing to shortage of staff a large amount of overtime is being worked; this is welcomed by the workers. The award takes effect from the first pay day in September. The towns concerned in the increases are Manchester, where nearly 5,000 workers are affected; Salford, where the increased charge is estimated at £9,000 a year; Accrington, Ashton-under-Lyne, Blackburn, Birkenhead, Bolton, Burnley, Bury, Colne, Darwen, Oldham, Preston, Rochdale, Stockport, Wallasey, Warrington, Wigan, and the areas covered by the Stalybridge Joint Tramways Board and the South Lancashire Tramways Co. A leading tramway official in Manchester declares that as the advances will mean a big strain upon the departments, the possibility is that there will be a general increase of tramway fares throughout Lancashire.

Leeds.—Interviewed, last week, in regard to the Coal Controller's suggestion that economies might be effected by curtailment of some public services—as, for instance, early and late cars—Mr. J. B. Hamilton, the general manager, stated that the service there had already been curtailed so much that further steps in that direction were hardly likely, and it was at the instance of the authorities that special early morning and late evening cars were running. The whole question of the service, both as to number of cars and the number of people who drive and conduct them, was now engaging the attention of the Committee. The present service was not quite adequate for the number of people who wish to travel.

London.—The L.C.C. is making the following modifications in the availability of transfer and workmen's tramway tickets, commencing on October 3rd:—

1. Transfer tickets will only be issued for journeys where no through cars are run. Passengers who can make their journey without a change are requested to take a through car. Passengers who hold transfer tickets must change at the point indicated on the fare bills; such tickets will not be accepted at other points.

2. Workmen's tickets will only be available for the second journey between the same points as on the first journey.

These changes are made to overcome operating difficulties caused by war conditions.

Newcastle-on-Tyne.—Rating Appeal.—The Tramways Committee has issued another report relative to the assessment of the tramway undertaking for the poor rate. The Assessment Committee has intimated its willingness to reduce the assessment for the three past years to which the Corporation had objected, but the rates have not been amended, and the Tramways Committee has been forced, as a last resource, to appeal to Quarter Sessions, or lose its remedy, and appeals are pending in respect of the poor rates made for 1915, 1916 and 1917. The Tramways Committee is advised that the rates do not conform, and cannot be made to conform, with the valuation list. The hearing of the appeal was fixed for to-day.

At the invitation of the general manager of the tramways, representatives of the local shipbuilding and engineering yards on the Tyne and the Trade Unions concerned, met to consider the complaints as to the inadequacy of the service of workmen's cars, and the fact that the local Tribunal is considering the wisdom of cancelling the exemptions of some of the men employed on tramway repairs and maintenance. After discussion, it was decided that the general manager should draw up a statement as to the position of the tramways, and that it should be supported by the firms and Trade Unions represented, so that the matter might be brought urgently before the Ministry of Munitions, that the situation might be relieved, or, at all events, that the staff should not be further depleted.

TELEGRAPH AND TELEPHONE NOTES.

Japan.—The Japanese Diet has voted a large appropriation for the extension of the telephone system in Japan.—*T. and T. Age.*

Telephone Development of the World.—Europe, which had 3,910,000 telephones, at the beginning of 1914, had at the beginning of the current year probably 4,180,000, made up as follows:—

Great Britain (including emergency stations)	...		812,000
Russia (January 1st, 1916)	...	...	400,000
Sweden (271,797 at January 1st, 1916)	...	(say)	288,000
Denmark (150,000 at January 1st, 1916)	...	(say)	165,000
Norway (94,000 in January, 1915)	...	(say)	100,000
Netherlands (78,743 at January 1st, 1914)	...	...	100,000
Switzerland (January 1st, 1917)	...	...	104,000
Spain (36,660 at January 1st, 1915)	...	(say)	50,000
Austria (170,000 at January 1st, 1915)	...	...	170,000
Germany (pre-war)	...	...	1,421,000
France (pre-war)	...	...	310,000
Italy (pre-war)	...	...	95,000
Belgium (pre-war)	...	...	51,000
Hungary, the Balkans, Portugal, Luxemburg, &c. (pre-war)	...	...	114,000
			4,180,000

Great Britain has increased from the pre-war figure of 774,000 and even if the "emergency stations" be eliminated, a small increase is still shown. London, despite statements in the Press to the contrary, has increased from 259,000 to 269,538.

Asia had 303,000 telephones at the beginning of 1914. Since then there has been an increase of [illegible]000 in Japan, 6,000 in Siberia

and about 2,000 in Corea, Manchuria, and Formosa. We may safely put the total for Asia at 340,000.

There were 59,500 telephones in Africa in 1914. The figures for South Africa had increased by 4,000 by the beginning of 1916. There were at least 66,000 stations in Africa at the beginning of this year.

There are 11,300,000 telephones in the United States. Canada had 583,090 in June, 1915. The total for North America is at least 11,920,000.

In South America there were about 170,000 telephones in 1914, and there cannot be less than 230,000 stations working at present.

Official figures show that there were 168,416 telephones in Australia on June 30th, 1916. New Zealand had 58,796 and Hawaii 7,000. Total, 234,000.

In January, 1913, there were about 13,500,000 and in 1914 14,500,000 telephones in the world. At January, 1917, there must have been close upon 17,000,000.—W. H. GUNSTON, in the *Telegraph and Telephone Journal*.

CONTRACTS OPEN AND CLOSED.

OPEN.

Morecambe.—October 15th. Electric Traction Committee. Supply of electrically-driven omnibus. See "Official Notices" to-day.

CLOSED.

Accrington.—Electricity and Tramways Committee. George Hargreaves & Co.: 500 tons of coal per month for a year, at existing prices, subject to any increase or decrease fixed by the Coal Controller.

Barrow.—T.C.:—

Steam tube-cleaning apparatus.—Boiler Tube and Flue Cleaner Co., Ltd., £173.
Switchgear.—British Thomson-Houston Co., Ltd., £909.
Graving-dock switchgear.—Ferranti, Ltd., £388.
Switchgear.—Ferranti, Ltd., £930.
Transformer.—Ferranti, Ltd., £369.
Cables.—B.I. & Helsby Cables, Ltd., £1,718.

Bexhill-on-Sea.—T.C. 1,000 tons of Manners' washed peas or Shipley peas, for the electricity works: Myers, Rose & Co., 28s. 7d. per ton, carriage paid in truck at Bexhill.

Dublin.—Corporation Electricity Committee. Green economiser: G. N. Haden & Sons.

November 1st. G.N. Railway Co. (Ireland). Six or twelve months' supply of general stores (including several electrical items). See "Official Notices" to-day.

Erith.—U.D.C. H. Friday & Sons: Extensions to electricity works.

Ilford.—U.D.C. Accepted tenders (the lowest in each case):—

General Electric Co., Ltd.—Converting plant, £2,459.
W. T. Henley's Telegraph Works Co., Ltd.—Cable, £1,492.
Albion Clay Co., Ltd.—Conduits, £536.

Walthamstow.—U.D.C.:—

Tudor Accumulator Co., Ltd.—Renewal of contract for maintenance of battery at the Sanatorium for ten years, at £28 per annum.

FORTHCOMING EVENTS.

Salford Technical and Engineering Association.—Saturday, October 6th. At 7 p.m. At the Royal Technical Institute. Lecture on "The Panama Canal," by Mr. R. Barker.

Chief Technical Assistants' Association.—Saturday, October 6th. At 3 p.m. At Tavistock Hotel, Covent Garden. Discussion on "Recent Developments in respect of Organisation of Staff in Electric Light Undertakings."

University of London University College.—Wednesday, October 10th. At 7 p.m. At Gower Street, W.C. Lecture on "The Engineering Plant in Large Hotels," by Mr. A. H. Barker.

Birmingham and District Electric Club.—Saturday, October 13th. At 6.30 p.m. At the Swan Hotel, New Street. Ladies' night.

NOTES.

Women Tramway Employes Assaulted.—At the Huddersfield Police Court last week, Edward Downs, stoker, was fined 40s., and ordered to pay 10s. witnesses' expenses, on a charge of assaulting Emily Bradley, tramcar conductress, on September 7th, the defendant being a passenger on a car on the Leeds Road route, on which the complainant was on duty. Mr. Proctor (deputy town clerk), who prosecuted, said the girl conductresses on that route were insulted almost every day, and the Tramways Committee hoped the Bench would deal with such cases very firmly.

Exports to China.—The *London Gazette* for October 2nd contains a further list of persons and bodies in China to whom exports may be consigned.

Educational.—UNIVERSITY OF LONDON, UNIVERSITY COLLEGE.—Prof. J. A. Fleming, F.R.S., will deliver a public lecture on "The Work of a Telephone Exchange," on Wednesday, October 17th, at 5.30 p.m., and a course of six lectures on "The Principles of Modern Telegraphy," on Fridays, at 5 p.m., beginning October 26th, 1917. The public lecture is open without fee or ticket. The course is open both to members and non-members of the University. Fee, £1 11s. 6d. Application for tickets of admission to it should be made to the Secretary, University College, Gower Street, W.C. 1.

Volunteer Notes.—COUNTY OF LONDON VOLUNTEER ENGINEERS (FIELD COMPANIES).—Headquarters, Balderton Street, Oxford Street, W. 1.

Orders for the week, by Lieut.-Colonel Clay, V.D., commanding:—
Officer for the Week.—Second Lieut. P. Bowden.
Monday, October 8th.—Drill and Elementary Bridge Construction for No. 3 Company, Left Half Company, 6.30. Signalling Class, 6.30. Recruits' Drill, 6.30.
Tuesday, October 9th.—Headquarters closed.
Wednesday, October 10th.—Drill and Elementary Bridge Construction for No. 1 Company, 6.30.
Thursday, October 11th.—Drill and Elementary Bridge Construction for No. 2 Company, 6. Signalling Class, 6.30. Ambulance Class, 6.30.
Friday, October 12th.—Drill and Elementary Bridge Construction for No. 3 Company, Right Half Company, 6.30.
Sunday, October 14th.—Commandant's Parade for work at Esher. Parade 8.15, Waterloo Station, opposite No. 10 Platform.
Musketry.—The Range at Belvedere Road will be open every Tuesday, Wednesday, and Thursday evening from 5.30 to 7.
Medical Examination.—The Medical Officer will attend at Headquarters for this purpose every Thursday at 6.

(By order) MACLEOD YEARSLEY, *Capt. and Adjutant.*

The Question of Combination.—In view of the interest which is being taken in the Government recommendation to our manufacturers to combine in their operations in readiness for after-the-war conditions, in competition with other countries, the remarks of Sir J. E. Johnson Ferguson, at the annual meeting of Messrs. Bolckow, Vaughan & Co., Ltd., may be quoted. He said that during the last few months they had heard a great deal about the advantages of combination. Some gentlemen had held up the United States Steel Corporation to their admiration, and asked them all to sink their individuality in one concern. Others, again, had extolled the advantages to be derived from copying the method of the German *Verband*. He, personally, did not agree with a great deal of what those gentlemen said. Small concerns, he admitted, would not be able to live in the competition of the future, but they could not describe Bolckow, Vaughan & Co. as a small concern, and it would require very conclusive evidence of the advantages to be derived by the shareholders before he would be disposed to recommend such a change as was advocated by these gentlemen. There were, however, two directions in which he thought useful developments might be made by arrangements amongst manufacturers. A great deal of useless changing of machinery might be avoided, and in that way by continuous running over a long period without a change, the output of machinery might be considerably increased. The same policy which had led to standardised ships being built should be much more largely extended than it was now to all other classes of production. The other direction in which he thought the iron and steel manufacturers of this country might, with advantage to themselves and to our national trade, act together, was that of securing the control of some of the undeveloped sources of supply. If Germany lost Alsace-Lorraine, and he supposed there was not one of them who could contemplate a termination of the war with any other result, she would lose her principal domestic source of iron ore supply. They all knew how vigilant the German Government was to foster and protect the interests of its manufacturers. They might naturally assume, therefore, that one of the very first steps it would take, after the close of the war, would be to try to secure the control of some of the principal iron ore fields of the world. The principal of those fields were far too big and important for any one individual concern to tackle, and the only way in which our interests could be protected was by the formation of a company representing the consumers, and possibly the merchants, of this country, to acquire and develop some of these supplies, and it seemed to him that if there ever was a case in which it was desirable for the Government to interest itself, this was such a case.

Fused Silica.—Israel Rosenblum, of Swampscott, Mass., has patented a method of producing articles of fused quartz in an atmosphere of nitrogen in graphite crucibles. The method is based upon the discovery that if a transparent quartz tube is slipped over a graphite rod and heated to a temperature between 1,400° and 1,600° Centigrade in a nitrogen atmosphere, a compound of silicon, nitrogen and carbon is formed, which acts as a protective coating over the graphite rod, and prevents further action on the graphite by the quartz. As the melting point of the compound of silicon, nitrogen and carbon, when once formed, is far above the temperature needed to render the quartz plastic, which is about 1,800° Centigrade, it follows that this compound acts as a protective layer, not permitting the quartz to be contaminated by the graphite. In practice, illuminating gas may also be used.—*Met. and Chem. Engineering.*

Dangers of Gas Lighting.—A serious accident recently occurred in India from an unusual cause. A gas cylinder came adrift from underneath the coach of a passenger train whilst running on the Madras and Southern Mahratta Railway between Biccavol and Anaparthi, due to one of the supports failing. The cylinder appears to have been fully charged with gas, and when it fell at one end on to the permanent way, the bogie of the moving vehicle caught it, crushed and forced it up through the floor of the carriage, where it exploded, partially wrecking the carriage and seriously injuring several of the occupants.—*The Locomotive.*

Decimal Coinage.—In issuing a pamphlet dealing with the existing British system of coinage and the proposed method of reform, which we have already noticed, the Decimal Association states that its efforts are now reinforced by the recommendations of the Institute of Bankers and the Association of Chambers of Commerce, all three bodies being in agreement that the desired change can best be accomplished by retaining the £ sterling as the monetary unit, and dividing it decimally, a course which would leave the values of all our gold and silver coins unchanged. It is pointed out that the purchasing power of the penny has completely changed during the war, and that the inflexibility of our subsidiary coinage has been one of the causes accentuating the high prices of daily necessities, which have been the root of so much industrial unrest; the present proposed changes, instead of being against the interests of the industrial classes, will in reality be of advantage to them. One has only to recall the many instances of the prices of halfpenny goods and services being raised to a penny, and of penny goods being raised to three halfpence for lack of an intermediate coinage, to realise the truth of the statement.

These advances of 100 per cent. and 50 per cent. respectively have been made when perhaps 20 per cent. would have reimbursed the sellers for their increased cost, and the introduction of new subsidiary coins, having values intermediate between our present halfpenny and penny and between our penny and three halfpence, would accordingly be a great boon to the consumers of "penny-worths" in any form.

It is certain that the pre-war level of prices cannot be restored for a long time to come (if ever), and that the provision of an enlarged range of low-denomination coins in closely graduated steps would accordingly afford much relief to our hard-pressed people, while enabling the seller to get a fair increase of price for his article. It is the aim of the Association simultaneously to provide the desired relief and to confer the benefits of decimal coinage upon the nation, thereby removing a burden which for years has oppressed all classes. Expressions of opinion on the subject will be welcomed by the Association.

Electrode Cooling.—A simple arrangement of the water cooling on electrodes, introduced by the writer some time ago, on the Heroult furnace at the Hussey-Binns Steel Co. plant, has worked very satisfactorily. The accompanying sketch, showing the arrangement as applied to the middle electrode, gives the principle.

The cooling water comes through the armoured hose (1) to distributing box (2), fastened on the outside of the columns for the electrode-holders. Only three pipes go out from the distributing box—one to each electrode, each of which is furnished with a regulating valve. Where the pipe passes the roof-ring a piece of rubber hose (3) is inserted for insulation, and connected with a

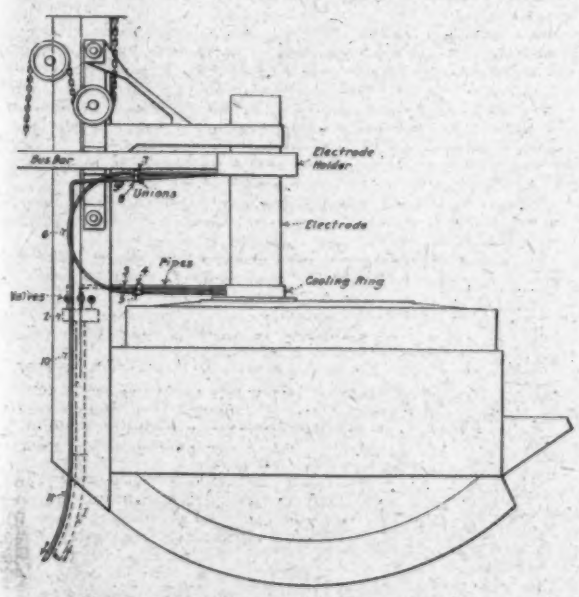


Fig. 1.—Arrangement for Water Cooling.

union (4) to the pipe which goes to the cooling ring. The return pipe from the cooling ring is connected with a union (5) to the rubber hose (6), which is sufficiently long to allow for total electrode movement and some surplus to prevent kink. This rubber hose is again, by means of union (7), fastened to the pipe leading to the electrode-holder, and the return pipe from this is, by means of union (8) and rubber hose (9), connected to the downfall pipe (10), which is fastened to the electrode carriage. From the pipe (10) the armoured rubber hose (11) leads to the common waste-water box.

The advantage of the arrangement is that all pipes on the furnace can be very easily drained in case of cold weather, when the furnace is out of operation, and freezing of the water is to be feared. Disconnection of the unions of the armoured feed hose (1) and waste hose (11) will give complete drainage.

In case muddy river water is used for cooling, it is advisable not to thread the ends of the pipes on which the hose from the cooling rings are fastened. This avoids danger when, after a clogging up, steam will be suddenly developed in the cooling ring, causing the hose to blow off.

A further advantage is that very little rubber hose is used, and only three valves are to be operated by the furnaceman.—Haakon Styri, in *Met. and Chem. Engineering*.

Aeronautical Institute of Great Britain.—The membership of this Institute, which is now nearly 1,000, has recently been re-classified, and it is hoped that the Associateship, which is open to accredited members of the public, will be largely availed of by the rank and file of the industry, for whose benefit a special course of aeronautical engineering instruction will be organised.

New Allied Conference in Paris.—According to Reuter (quoted in the *Times*), an inter-Ally Conference to deal with the treatment of enemy goods in occupied territory will meet in Paris on October 8th.

Practical Experiences with Tough Rubber Compound Cables.—In the last line of the article by Mr. W. Ellerd-Styles, on page 292 of our last issue, the word "brushes" should read "bushes."

Appointments Vacant.—Assistant mains superintendent (45s.) for the Rochdale Corporation Electricity Department; shift engineers for Eccles Corporation and Stepney B.C. See our advertisement pages to-day.

The Kensington and Notting Hill Arbitration: Award.—With reference to the arbitration proceedings in respect of the Kensington and Notting Hill Electricity Supply Companies, which were reported in the Electrical Review in July last, we understand that the arbitrator has issued his award, finding in favour of the Kensington and Knightsbridge Co. on all points, subject to the decision of the Court on the legal construction of the agreements, and other points of law.

A French Exhibition of Industries.—The French nation are tackling in a very practical manner the question of rendering themselves independent of German and Austrian manufacturers. No society has been more active in this campaign than the Société d'Encouragement pour l'Industrie Nationale, of Paris. Last June the society organised, and held at their headquarters, a representative exhibition of French products. The exhibits included: (1) articles which previous to the war were not manufactured in France at all; (2) goods which prior to the war were manufactured in areas now in enemy occupation, but which have since been manufactured in regions without the Army zone. Over 71 firms showed exhibits, and the experimental electrical section was well represented. A number of manufacturers are now giving their attention to the production of glasses suitable for electric lamps, and have succeeded in turning out a satisfactory article as the exhibits demonstrated. Blown glass-work for such articles as Geissler tubes, &c., was shown. Particular interest was shown in some specimens of the Coolidge tube which one French manufacturer has taken up enthusiastically, and which, as Prof. Féry points out, is likely to assume great importance in the future in connection with the radiographic examination of metals.

A representative series of ebonite goods was shown. This class of article France obtained largely from Germany before the war, but it is now demonstrated that she can turn out articles which will answer the purpose just as well. As is the case with England, the French are taking steps to ban German-made magnetos altogether. A number of types were shown by various motor manufacturers and others. Small electric motors, too, are now being manufactured in France for a variety of purposes. For obvious reasons, very little was shown in the way of heavy electrical machinery or instruments. When practically every firm in France is engaged on war work, it is most praiseworthy to find that many are able to show that in the efforts of that country towards reconstruction, they are not neglecting the practical measures necessary in attaining the desired end. The French society mentioned above, from whose *Bulletin* for July—August these notes are compiled, is rendering signal service.

German Enterprise in Switzerland.—In *l'Industrie Electrique* it is stated that Germany is specially interested in the electrical and mechanical industries, metallurgy, construction, and financial groups controlling these industries, in Switzerland. In electricity, the Berlin group represented by the A.E.G. disposes of more than 275,000 H.P., and a capital of over 600 million fr., of which 340 millions are represented by shares, and 308 millions by loans. The Siemens group controls 310 million fr. German, or Swiss-German, *personnel* plays an important part in the administration of the enterprises in which German capital participates; thus, the Banque des Chemins de Fer Orientaux of Zurich includes, amongst 17 directors, 8 Germans and 1 Austrian; the Banque pour Entreprises Electriques, in Zurich, includes 16 Germans and only 7 Swiss; the Metallgesellschaft, of Basle, 9 Germans to 6 Swiss.

Electrical Smelting of Iron Ore.—It is announced that a new electrically-operated iron smelting plant has been built, and has commenced operations, at the Porjus Falls, this being the first attempt to treat North Swedish iron ore on the spot. The first furnace to be started is said to be producing 8 tons daily, and the output is to be raised to 20 tons per day by the starting of a second iron pyrites furnace. The erection of a third furnace to produce chrome and other alloy iron is also in contemplation.

The Industrial League.—We have received from Mr. H. Scholey, hon. secretary of the Industrial League, a pamphlet describing its objects and methods, and containing a number of appreciative extracts from Press comments. The League is the outcome of a series of small meetings of employers and prominent Labour leaders held during the past two years, with the object of bringing employers and workers together in friendly relationship—perhaps the most important and urgent necessity of the time. Its mission is chiefly an educational one, and its mode of operation is the dissemination of information with a view to enabling employers and workers better to understand each other's position with regard to social and industrial questions. Considerable success has already been achieved in this direction at the London meetings, and the League proposes to establish local Associations of the same character in large centres of industry throughout the country, which would be affiliated to the parent body and assisted in carrying on their work. It is essential to secure direct contact with the workers, and this will be effected through the medium of the Trade Unions and men who are closely associated with Labour. Both employers and workers will be represented on the General Committee, which is in process of formation. The League will work in co-operation with all Associations which have similar aims; its position is epitomised in the following general statement:—

Having regard to the fact that the war will leave the nation burdened with a huge debt, it is necessary to increase the general output of the community, and it is of vital importance that greater and more friendly co-operation shall exist between employers and employed.

It is essential, first, that the social conditions of the people should be elevated; secondly, that the greatest possible output be obtained in every industry; and, thirdly, that all industries, small as well as large, should be encouraged in every possible manner.

Agreements should provide for every willing worker, wages that will assure a certain and secure existence for himself and his dependents. A guaranteed minimum wage is therefore essential to the workers in every industry.

To encourage output, rates of wages should provide that the exercise of superior skill should be fully rewarded.

Considerable funds will be required to carry out its objects, and subscriptions (£1 per annum for individuals, £2 for firms) and donations are invited by the hon. treasurers, Mr. G. J. Wardle, M.P., and Mr. Lee Murray. Mr. J. Ames shares with Mr. Scholey the office of hon. secretary, and the address of the League (*pro tem.*) is 56, Victoria Street, S.W. 1.

Household Coal Distribution Order, 1917.—Owing to doubts as to the scope of the order, buildings not used as private dwelling houses (such as schools, hospitals, bakehouses, public halls and institutions, offices, &c.) have largely failed to make out requisitions for the assessment of their supplies of coal, coke, or other fuel commencing October 1st, so as to comply with the terms of the Order. As it is not desirable that a difficulty of this kind should in many cases interrupt the usual supplies to such buildings, registered coal merchants may continue their deliveries during the month of October, even although they hold no certificate authorising the supply. The merchants should at once give notice to their customers calling attention to this failure on their part to complete the necessary requisitions, so that the supply may be regularised as quickly as possible. It should be noted that where a supply of coal, coke, or other fuel is used partly for industrial purposes and partly for heating, cooking, or domestic purposes, a requisition will be required for such part of the supply as comes within the scope of the Order. The Order comes into force on October 1st, with regard to all buildings used as a private dwelling house or dwelling houses, and no extension of time is permitted in their case.

Coal Wagons.—The *Times* states that it is now confidently expected that the Controller of Coal Mines will have a sufficient number of railway and privately-owned coal wagons at his disposal by October 15th to remove all ground for anxiety about the conveyance of coal from the collieries to the various depôts established throughout the country. In this work the Controller has had the loyal co-operation of all the railway companies.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Mr. H. Barson has been appointed charge engineer at the Dover Corporation electricity works, *vice* Mr. A. H. Jones, resigned.

The Liverpool City Council is being asked to grant a large number of increases in salary to Corporation officials, the total amounting to something like £3,500 a year. Included amongst them are the following:—Tramways Department: Mr. C. W. Mallins, general manager, from £1,250 to £1,500; Mr. T. Coole, engineer's assistant, from £400 to £500, rising 12 months later to £550; Mr. T. Ridyard, rolling stock and works superintendent, from £400 to £500, rising in 12 months to £550. Electricity Supply Department: Mr. H. Dickinson, city electrical engineer, from £1,500 to £1,600; Mr. P. J. Robinson, superintendent engineer of stations, from £500 to £700, and to be appointed chief engineer's assistant; Mr. L. Breach, assistant electrical engineer, from £370 to £425, and to be appointed engineer's assistant. City Lighting Department: Mr. A. G. Smith, lighting engineer, from £500 to £550. The proposals have met with some criticism outside the Council, and Ald. Burgess has given notice of motion that all suggested increases of salaries over £1,000 a year be deferred for 12 months.

The Kingston-on-Thames Lighting Committee recommends that the salary of the electrical engineer (Mr. T. A. Kingham) be increased by £50 a year, with a further increase of £25 a year hence.

General.—Electrical men will receive with interest the announcement that Lord Rhondda has recognised the organising ability of Mr. H. B. Renwick, managing director of the County of London Electric Supply Co., Ltd., and has appointed him to act as Director of Feeding Stuffs at the Ministry of Food. Mr. Renwick will be charged with the duty of organising the supply and distribution of oil cakes and other cattle food. At Lord Rhondda's special request the directors of the County Co. have agreed to loan Mr. Renwick's services for the purpose mentioned.

Mr. Wm. Lunn, A.M.I.E.E., who returned from California, U.S.A., in the fall of 1915, has left Messrs. R. W. Blackwell and Co., Ltd., to take up a position as electrical surveyor with the Norwich Union Fire Insurance Society, Ltd.

At Morecambe, last week, Mr. Oswald G. Cook, electrical engineer under the Royal Engineers, at a military power station, was married to Miss Hannah Hardill, daughter of Mr. Wm. Hardill, of Messrs. Wm. Hardhill, Sons & Co., Ltd., Netherfield Foundry, Cleckheaton.

Mr. J. Flanagan, of Bolton, has been appointed electrical engineer to the Tees Side Bridge & Engineering Works, Ltd., Middlesbrough.

The directors and staff of the Midland Electric Light and Power Co., Ltd., have presented an inscribed gold watch to Lance-Corporal A. J. Whitehead, Signalling Company, R.E., who recently gained the Military Medal for good work in the field.

For his services in having the Dublin & Lucan Electric Railway placed under Government control, the manager, Mr. D. McDowall Grosart, has been presented, on behalf of the shareholders and users, with a gold watch and a cheque.

Roll of Honour.—Major Gordon Spencer Marston, an electrical assistant with Messrs. Berry, Skinner & Co., who enlisted as a private in the Royal Engineers at the beginning of the war, and obtained a commission after being wounded in 1915, was mentioned in a dispatch by Sir Douglas Haig for excellent and exceptional work. He has now reached the rank of temporary Major, and has been granted the Military Medal.

We regret to learn that Lieut.-Col. Robert Whitehead Hammond, Royal Fusiliers, died on September 30th of wounds received two days previously. Lieut.-Col. Hammond was the only son of the late Mr. Robert Hammond. He was an Associate Member of the Institution of Civil Engineers, a Member of the I.E.E., and was a partner with his father in the consulting engineering firm, Robert Hammond & Son.

Lieutenant A. J. Adamson, R.G.A., accountant to the Oxford Electric Co., Ltd., has been killed in action.

Private S. Bishop, London Regiment, and Driver H. Scott, R.F.A., both formerly in the general office of the India-Rubber Co., Silvertown, have been wounded in France.

Gunner J. Illingworth, who was employed by the Phœnix Dynamo Co., of Bradford, has died of wounds received in action.

Private J. Whalley, Machine Gun Corps, who has been killed in action, was employed by Messrs. Dick, Kerr & Co., Preston.

First Air Mechanic S. Hall, R.F.C., has gained the D.C.M., for conspicuous gallantry. His wireless station came under heavy fire, and the aerial was shot down three times, but he re-erected it on each occasion, eventually restoring communication with his aeroplane. Before joining the Army he was a telegraphist at the G.P.O., Manchester.

Lance-Corporal F. Baldwin, Signalling Corps, R.E., and attached to the cable section, has been awarded the Military Medal for repairing telegraph wires under heavy fire. He was employed as a linesman at the Burnley Post Office.

Private R. Rogerson, Lancashire Fusiliers, who has been killed in action, was for 10 years employed by Messrs. I. Frankenburg & Sons, Ltd., cable manufacturers, Salford.

Private W. Capstick, Scots Guards, has died from wounds received in action. He was employed in the Blackpool Corporation electricity department as a cable layer.

Rifleman H. Emmens, Rifle Brigade, killed in action, was employed by the British Westinghouse Co., Ltd., Trafford Park.

Mr. J. Wilkinson, wireless telegraphist in the R.N.V.R., has been killed. He was employed by the British Westinghouse Co., Ltd., Trafford Park.

Signaller B. G. Allday, of the K.Q. Royal Lancaster Regiment, whilst serving as a wireless operator in the signalling section on August 6th, conducted himself with such gallantry as to earn the commendation of the officer commanding. He was a Blackpool-Lytham tramway employé.

Private H. E. Whetton, Lancashire Fusiliers, who has been killed in action, was employed by the British Westinghouse Co., Trafford Park.

Private D. Bradshaw, who is wounded, was employed by the St. Helens Cable & Rubber Co., Ltd., Warrington.

The Military Medal, for carrying dispatches under heavy shell fire, has been awarded to Private A. Breens, London Regiment, a member of the staff of the Croydon electricity works.

Lance-Corporal W. J. Fussell, R.E., an electrician with Messrs. R. Kendall & Sons, of Bath, has fallen in action.

Gunner A. E. Tagg, R.F.A., who was engaged at Stafford with Messrs. Siemens Bros., Ltd., has fallen in action.

Gunner E. J. Hedgecock, R.G.A., who has fallen in action, was engaged at the Dover Corporation electric light works.

Mr. Reginald Dodd, W.O., R.N.A.S., who has lost his life by drowning, served his articles at the Canterbury municipal electricity works under Mr. Blascheck, and later held an appointment with the Tramway Co. at Sheerness.

Second-Lieutenant R. B. Gaskin, Northumberland Fusiliers, who has fallen in action, was on the staff of Messrs. Aiton & Co., of Derby.

Sapper F. A. Button, R.E., who has died from fever at Basra, was on the staff of the Bromley (Kent) Electric Light Co.

Captain R. H. Uhthoff, R.E., who was before the war chief electrical engineer to Messrs. Pilkington Bros., Ltd., of St. Helens, has been wounded in action.

Private F. C. Foskett, employed by the Birmingham electric supply department, has been killed in action, aged 19.

Second-Lieutenant N. C. Whittall, R.F.C., a member of the staff of Messrs. Elliott Bros., Ltd., was killed in action on September 13th.

Private N. Dennis, aged 21, an employé of the Halifax Corporation tramways, has been awarded the Military Medal for bravery. He was wounded on the day on which he earned his award.

Private A. Cameron, employed in the electrical department of the Glasgow Corporation car works at Coplawhill, has been killed in action.

Obituary.—Mr. John Hesketh.—We regret to learn from the Australian papers that are to hand this week, that Mr. John Hesketh, A.M.I.C.E., M.I.E.E., chief electrical engineer to the Commonwealth Postal Department, passed away in July, after an illness of several months, at the age of 49 years. As many of our readers will remember, Mr. Hesketh went out from this country in 1896 under engagement to the Queensland Government for the purpose of organising that State's telegraph and telephone service. Ten years later, says the *Australian Statesman*, the postal, telegraph, and telephone services of the various States having in the meantime been taken over by the Commonwealth Government under the federation scheme, Mr. Hesketh was appointed chief electrical engineer to the Commonwealth, and it is due to him that the telephone and telegraph systems have been remodelled. "Amongst other changes brought about by him, he was responsible for the introduction of the common battery system in telephone working and the adoption of the toll system of subscription. His official and professional career was marked by enthusiasm for his work and readiness to assist young men who showed themselves capable of a similar attachment to it, and a desire to rise in their profession by merit, and not to rely upon promotion by right or seniority. His loss will be very great to the department." He was the local hon. secretary and treasurer of the I.E.E. Several years ago Mr. Hesketh was sent by his Government to America on a tour of investigation, and it was as a result of that visit that the change over to common battery working was made. He held a commission in the Australian Engineers, and since the outbreak of war he had acted in an advisory capacity to the Defence Department on telegraphic and telephonic questions. Of the two sons of the deceased gentleman, one left Australia several months ago for work on munitions in England.

Mr. E. H. Johnson.—We read in an American contemporary that Mr. Edward H. Johnson, aged 72 years, a former telegraphist, and for many years associated with Mr. Thomas A. Edison in the introduction of the latter's early inventions, recently died in New York. Mr. Johnson was instrumental in introducing automatic telegraphy, and was at one time president of the Magnetic Club. He was one of the most prominent figures in electrical circles from 1875 to 1900, since which time his health had failed him.

Will.—The late Sir George White left £185,000 gross, and £137,000 net personalty.

NEW COMPANIES REGISTERED.

J. B. & J. Atherton, Ltd. (148,540).—Private company. Registered September 26th. Capital, £1,000 in £1 shares. Manufacturers, merchants, importers and exporters of, and contractors for, fuel oil, ammonia, creosote salts, fuel of all kinds, and for all kinds of motive power, coal, coke, breeze, and peat merchants, manure and chemical manufacturers, mechanical and electrical engineers, &c. The subscribers (each with one share) are:—J. B. Atherton, 12, Sandringham Drive, Liverpool, merchant; J. Atherton, Hurst House, Huyton, near Liverpool, merchant. The first directors are:—J. B. Atherton and J. Atherton. Solicitor: F. F. Gaskell, 71, Lord Street, Liverpool.

T. B. Watson & Son, Ltd. (148,546).—Private company. Registered September 26th. Capital, £6,000 in £1 shares. To take over the business of plumbers, electricians, and sanitary and heating engineers carried on by T. B. Watson, at Stockton-on-Tees and Middlesbrough, as T. B. Watson and Son. The subscribers (each with one share) are:—T. B. Watson, 12, West End Terrace, Stockton-on-Tees, electrical engineer and plumber; H. C. Watson, New Clyde Terrace, Stockton-on-Tees, electrical engineer and plumber. The first directors are:—T. B. Watson and H. C. Watson. Solicitors: Townsend & Bertrand Watson, Stockton-on-Tees.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Miniature Electric Vehicles, Ltd.—Issue on September 14th, 1917, of £1,000 debentures, part of a series of which particulars have already been filed.

Foster Construction Co., Ltd.—Issue on September 24th, 1917, of £900 debentures, part of a series of which particulars have already been filed.

Burt, Escaré & Denelle, Ltd.—Satisfaction to the extent of £1,500 between January 1st and August 18th, 1917, of debentures dated December 31st, 1915, securing £7,500.

CITY NOTES.

Manaos Tramways & Light Co., Ltd.—The report for the year ended April 30th last states that the economic conditions in the Amazon valley did not compare unfavourably with those which obtained during the preceding year, and the result indicates, says the *Financial Times*, a gradual return to prosperity in this district. Brazilian exchange improved slightly in the course of the year. The loss on remittances from Manaos was £12,231, against £13,093. The gross earnings from all departments exceeded those of last year, being £120,387, as compared with £110,524, while the operating expenses increased from £76,172 to £82,511. The net operating revenue carried to profit and loss account increased from £34,352 to £37,876. After providing for debenture interest, sinking fund, interest on loan, London office expenses, sundry charges, and loss in exchange, there remains a balance of £6,628. The directors recommend transferring to contingencies reserve £3,000, making a total of £26,725, to transfer to renewals reserve £3,000, making £30,000, and to carry forward £628.

Automatic Telephones (Australasia), Ltd.—The report for the year ended June 30th shows that the company is prosperous. The credit balance is £6,416, out of which a dividend of 10 per cent. will absorb £6,250, but it was proposed only to pay 1s. per share in August, and another 1s. in six months, or as the directors may determine. The reason for this is that, since the year closed, orders for 7,300 new lines have been accepted, which will tax the financial resources of the company in times like these. The orders are for Sydney, Melbourne, and Christchurch, N.Z. The company have 25,000 lines in operation in Australia, and 1,500 in New Zealand at the present time.

Halifax & Bermudas Cable Co., Ltd.—The net balance for the year ended June 30th, 1917, is £19,650, as against £12,745 in the preceding year. The interim dividend of 3 per cent. is followed by a further equal payment, both free of income-tax, leaving £16,650 to carry forward. The balance to credit of revenue account, which was £9,210, has been debited with £1,500 applied to dividend and £2,202 expended in repairs, and credited with £16,650 surplus revenue of the year, and it now stands at £22,158, subject to excess profits duty. The cable worked efficiently during the year. Mr. H. F. Russell has been elected a director in place of the late Mr. W. M. Kent.

Marconi International Marine Communication Co., Ltd.—The directors announce that allotment letters in respect of the issue of 250,000 new shares have been posted. The issue having been largely over-applied for, applicants receive an allotment equal to five-sixths of their holding, applications for less than that proportion being allotted in full.

British Electric Transformer Co., Ltd.—Interim dividend of 6 per cent. per annum (7 1/5d. per share), less income-tax, on ordinary shares for half-year.—*Financial Times.*

Stock Exchange Notice.—Application has been made to the Committee to allow the following to be quoted in the Official List:—

Melbourne Electric Supply Co., Ltd.—Further issue of £150,000 5 per cent. consolidated debenture stock.

Kalgoorlie Electric Power & Lighting Corporation, Ltd.—Dividend on the preference shares at the rate of 4 per cent. per annum for the six months ending September 30th.

Shawinigan Water & Power Co.—Dividend of 1¾ per cent. for the quarter ended September 30th on the common shares.

Switzerland.—Messrs. Brown, Boveri & Co., of Baden, have lately increased their capital from £1,280,000 to £1,440,000.

Callender's Cable & Construction Co., Ltd.—Interim dividend at the rate of 10 per cent. per annum on the ordinary shares for the half-year, the same rate as a year ago.

Fraser & Chalmers, Ltd.—The directors, with Treasury sanction, have been inviting applications for £100,000 6 per cent. first mortgage debentures of £100 each at 98½.

Montreal Tramways Co.—For the year ended June 30th last, while the gross passenger earnings show the satisfactory increase of 14.45 per cent. over last year, operating expenses increased by 24.14 per cent. The total expenditure on upkeep was $1,359,931, against $897,470 last year. After deducting bond and loan interest $858,542, interest on debenture stock $800,000, contingent account $350,000, and estimated war tax $110,000, there is a surplus balance of $77,473.

Direct West India Cable Co., Ltd.—For the year ended June 30th, 1917, the net result is a balance of £27,374, against £14,705 for the previous year. The interim dividend of 3 per cent. is followed by a further equal payment, both free of income-tax, leaving £24,674 to carry forward. The balance to credit of revenue account, which was £54,749, has been debited with £1,350 applied to dividend and £6,394 expended on repairs, and credited with £24,674 surplus revenue, and it now stands at £71,680, subject to excess profits duty. The cables worked efficiently during the year, but the insulation of the Bermudas-Turks Island section remains low. Mr. H. F. Russell has been elected a director in place of the late Mr. W. M. Kent.

Companies to be Struck Off the Register.—The following are to be struck off the register within three months unless cause is show to the contrary :—

Cleartone Antiseptic Telephone Drum, Ltd.
Electrolysers, Ltd.
Electromechan Co., Ltd.
Grip Nuts, Ltd.
Metallic Alloys, Ltd.
Tyrone Power Co., Ltd.
Universal Electric Contracts, Ltd.
Volta Instrument Co., Ltd.

STOCKS AND SHARES.

Tuesday Evening.

Most of the business this week has been in the air. Stock Exchange markets have been interfered with, mainly through the interruption caused to the postal services. This has extended to telegraphs as well as to letters; and, in addition to this, perhaps there was not quite so much desire to scout for business as there is in the ordinary way. When energies are directed mainly towards getting everything cleared up as soon as possible by the early hours of the evening, it is natural that business should go slowly.

The appearance of the new War Loan is another factor making for quietude amongst investment stocks. So far, the public have hardly become familiarised with the terms of the new issue, although no doubt its attractions will be more prominently set forth soon. The Stock Exchange is no whit disturbed; Consols even improved a little on the appearance of the prospectus. Great interest is shown, of course, as to the success which the loan is likely to achieve.

Want of trade in the Home Railway market is the principal feature there. The sudden rise in popularity of the Tubes and Undergrounds has not sufficed to stiffen prices. Metropolitans are ¼ lower at 23½. Districts and the Underground group hold their previous levels; and the rise in the Central London trio of assented stocks is well maintained.

During the last day or two something of a feature amongst industrials has been the weakness of Canadian securities. This has affected more particularly those of Canadian railway companies, but others are sympathetically influenced, the reason being that, in spite of the apparent prosperity attendant upon most of the undertakings, working expenses show a still more remarkable development, and increase instead of diminish. The railway companies are clamouring for power to raise their freight rates; and the industrial concerns will no doubt take steps to meet in other ways the constant rise in the costs of production. But for the time being Canadians are out of favour, and prices are depressed.

Home shares are more popular. There are no changes to record this week amongst the issues of the home electricity companies, but, on the other hand, there are very few shares to be obtained, and there is nothing which makes more greatly for market stagnation than scarcity of supply. It will be noticed from our lists that at the present quotations a return of 6½-7 per cent. can be obtained from such shares as Bromptons, Charing Cross preference, Chelseas, and South Metropolitan preference; but when a would-be buyer comes to inquire for shares, he is met so often with the reply that there are none on offer that he gives up the quest and puts his money into something else.

Amongst the foreign issues, Mexicans continue to mark time, although there is a good deal of hesitation displayed in regard to most of the stocks in this market, including those of the utility companies. News and rumour alike seem lacking. The inventive genius of the journalists who specialise in Mexican matters lies fallow; and, in the absence of any kind of stimulus, the market has relapsed into a state of torpor.

Brazils are moving closely along the path set by the course of exchange, and this just lately has been a little erratic. Consequently, Brazil Tractions remain weak at 46. British Columbia preference has fallen 2 to 40½; and although there is not much doing in the market, we are able to state that active measures are being taken by those who have in hand the protest against the apparent intention of the Municipality of Vancouver to enter into competition with the British Columbia Electric Railway.

The cable market is steady, with Globe ordinary and preference quoted ex dividend. Both shares have recovered part of the amount taken off the price. Anglo-American preferred is within a point of par; but West India and Panamas reacted to 1½. Oriental Telephones are 1/16 better, and Great Northern Telegraphs rose £1. The activity in Marconis is continued, and the parent shares have improved another 1/16 to 3⅜, while Americans are strong at 20s. 3d. Canadians, however, loiter around 10s. 6d.

The manufacturing list is quietly good. Babcocks rose to 3 5/16. British Aluminium ordinary have recovered to 32s. 6d. ex dividend. British Insulated at 14½ are the same price ex as they were cum; and British Westinghouse preference hardened to 3½, following upon their rise of 5/16 last week. General Electrics are again 10s. to the good at 17½, and the only decline in the list is a fall of 10s. in Henleys, due to a couple of hundred shares coming in on account of a deceased holder. Rubber shares are reasonably steady, notwithstanding a decline in the price of the raw material; and there is a fair amount of strength shown by shares in the armament group.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price Oct. 2, 1917.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	9	6¾	—	£6 18 6
Charing Cross Ordinary	5	5	6⅞	—	6 9 0
do. do. do. 4½ Pref.	4½	4½	6⅞	—	6 13 4
Chelsea	4	3	6⅞	—	5 9 1
City of London	8	8	15⅞	—	6 4 3
do. do. 6 per cent. Pref.	6	6	10½	—	6 18 5
County of London	7	7	11½	—	6 5 10
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	7	6	6½	—	5 14 8
London Electric	3	3	1	—	NB
do. do. 6 per cent. Pref.	6	4	8⅜	—	5 6 8
Metropolitan	3	3	6¾	—	4 12 4
do. 4½ per cent. Pref.	4½	4½	8⅜	—	7 4 0
St. James' and Pall Mall	8	8	7	—	6 14 6
South London	5	5	7⅜	—	7 5 6
South Metropolitan Pref.	7	7	21/6	—	6 10 3
Westminster Ordinary	7	7	6⅜	—	5 5 8
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	99	+ ½	6 1 0
do. Def.	22/6	1½	2⅜	—	6 10 5
Chile Telephone	8	8	7⅛	—	5 11 4
Cuba Sub. Ord.	5	5	8⅜	—	5 14 0
Eastern Extension	8	8	14⅜	—	*5 8 4
Eastern Tel. Ord.	8	8	14⅜	—	*5 7 9
Globe Tel. and T. Ord.	7	7	19 xd	+2/-	*5 7 8
do. Pref.	6	6	10⅜ xd	+2/-	5 15 8
Great Northern Tel.	23	24	28	—	6 6 4
Indo-European	13	13	54½	—	5 19 8
Marconi	10	15	3⅜	+ 1/16	4 9 0
Oriental Telephone Ord.	10	15	3⅛	+ 1/16	9 0 6
United R. Plate Tel.	8	8	6⅜	—	*5 16 4
West India and Pan.	6d.	6d.	1⅛	— 1/16	8 11 0
Western Telegraph	8	8	14⅜	—	*5 10 4
Home Rails.					
Central London, Ord. Assented	4	4	60½	—	6 12 8
Metropolitan	1	1	23½	— ¼	4 5 1
do. District	Nil	Nil	16⅜	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅞	—	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	6	4	82½	—	*4 17 0
Foreign Trams, &c.					
	Dividend 1915.	Dividend 1916.			
Adelaide Sup. 6 per cent. Pref.	6	6	4⅞	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½	5½	5⅛ xd	+ 1/16	5 14 0
do. 2nd Pref.	5½	—	2⅜	—	—
do. 5 Deb.	5	5	67⅛	—	7 8 8
Brazil Tractions	4	4	46	—	—
Bombay Electric Pref.	6	6	9⅜	—	6 4 3
British Columbia Elec. Ry. Pfcs.	5	5	40½	— 2	12 4 10
do. do. Preferred	Nil	Nil	30	—	Nil
do. do. Deferred	Nil	Nil	27½	—	Nil
do. do. Deb.	4½	4½	80	—	5 10 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	44½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	40	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	31½	+ ½	Nil
do. 1st Bonds	Nil	Nil	46½	—	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	3⅜	+ 1/16	4 11 0
British Aluminium Ord.	7	10	1½ xd	+ 1/16	6 8 1
British Insulated Ord.	17½	20	14½ xd	+ ½	7 0 4
British Westinghouse Pref.	7½	7½	3½	+ 1/16	4 15 10
Callenders	20	20	14½	—	6 18 0
do. 5 Pref.	5	5	4½	—	6 1 8
Castner-Kellner	22	22	3⅛	—	6 8 0
Edison Swan, fully paid	—	—	1⅛	—	Nil
do. do. 4 per cent. Deb.	4	4	73⅛	—	5 10 4
Electric Construction	7½	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	16⅜	+ ½	5 15 8
do. Ord.	18	10	17½	+ ½	5 14 8
Henley	25	25	15½	—	7 16 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	13⅜	—	*7 5 6
Telegraph Con.	20	20	20	—	*5 3 1

* Dividends paid free of income-tax.

THE HIGH-TENSION MAGNETO.*

(*Continued from page* 311.)

Aeroplane-Type Magnetos.

The greater number of the magnetos built in this country since the outbreak of war have been used on aeroplanes. This means that the British magneto industry, from the moment of its inception, had to contend with the most difficult problem of all, because an aeroplane magneto has to operate under more severe and exacting conditions than obtain on any form of motor vehicle.

The mantle of responsibility was borne during the early stages of the war by the firm of Thomson Bennett, in Birmingham (who, to their credit, were struggling to create a magneto industry before the war); the B.T.H. Co., in Coventry; and the M.L. Magneto Syndicate, in Coventry. More recently many newcomers have joined the industry, with the result that at the present moment there are no fewer than 15 manufacturers engaged on this most important work.

Special credit is due to the three manufacturers named above, and in particular to Mr. E. A. Watson, technical director of the M.L. Magneto Syndicate, and Mr. J. D. Morgan, of the Marks and Clark laboratory and consulting engineer to the firm of Thomson Bennett.

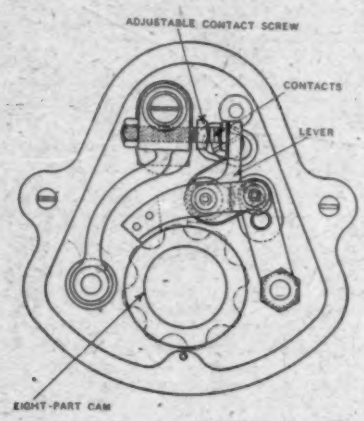


Fig. 4.—Contact-breaker of B.T.H. A 8 S Magneto.

As evidence of what has already been done, the author briefly describes in his paper some of the aeroplane-type magnetos that are now being produced in very large quantities by the three manufacturers mentioned.

The M.L. Magneto Syndicate type A.D.S. magneto, which is of the rotating-armature single-cylinder type intended for use on rotary engines of the Gnome, Mono-soupape, Clerget, or similar types, is based on the original Bosch D.A.L. design, but has been improved in many respects. The chief modifications which have been found necessary have been in connection with the contact breaker and the cams, as these machines have to run at a very high speed, from 2,500 to 3,500 r.p.m. Consequently, the whole Bosch design of flat cam, which gave rapid acceleration of the contact-breaker arm, has been given up, and the cams now fitted are made to a correctly-shaped profile, which is ground out on machines specially designed and constructed for the purpose.

In addition, it has been found necessary to increase the length of opening the primary circuit, in order to give time for the spark to die out when the machine is working at a high speed. This alteration has completely removed a trouble experienced with the D.A.L. type, of misfiring if the engine were inclined to be oily,

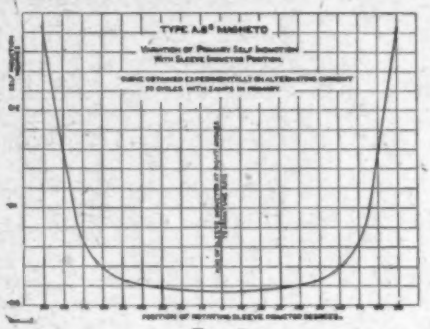


Fig. 7.

and has removed the necessity, previously apparent, for very close and careful setting of the plug points. It has also increased the life of the contact-breaker arm and the platinum points, and has made the machine suitable for use at much higher speeds. The cam is made from a continuous ring of steel, very carefully ground inside and out in order to ensure absolute concentricity.

The Thomson-Bennett type A.D.4 magneto is a four-cylinder machine of the rotating armature type, corresponding in size to the Bosch type Z.U.4 magneto used extensively in this country during the years preceding the outbreak of war. The Bosch design has been simplified, chiefly in respect of the construction of the bearing for the half-speed wheel, but many of the other features have been retained.

The B.T.H. eight-cylinder type A 8 S magneto is of the sleeve inductor type with fixed armature. It is designed to give four sparks per revolution, and is therefore fundamentally different from the ordinary rotating-armature type of magneto, which cannot give more than two sparks per revolution. The sleeve inductor rotates at engine speed. A six-cylinder machine (type A 6 S) is also built on the same principle, designed to run at three-quarter engine speed, but this differs from the eight-cylinder machine only in respect of the distributor and gearing.

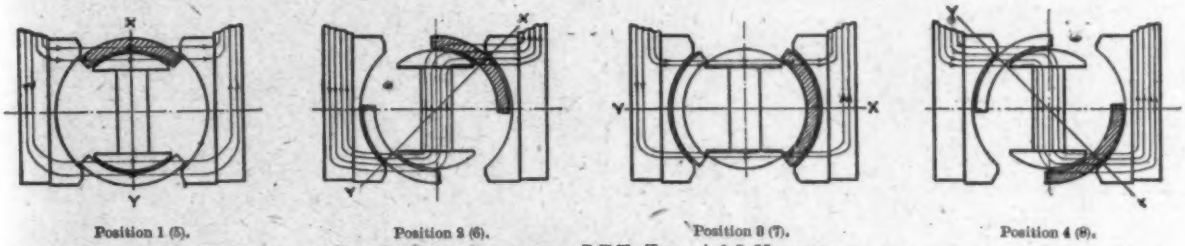


Fig. 5.—Flux Changes in B.T.H. Type A 8 S Magnetos.

The contact-breaker is shown in detail in fig. 4. A pivoted steel bell-crank lever arm carries at one end a fibre block which is actuated by the rotating eight-part hardened steel cam rigidly fixed to the distributor brush spindle, while at its other end the

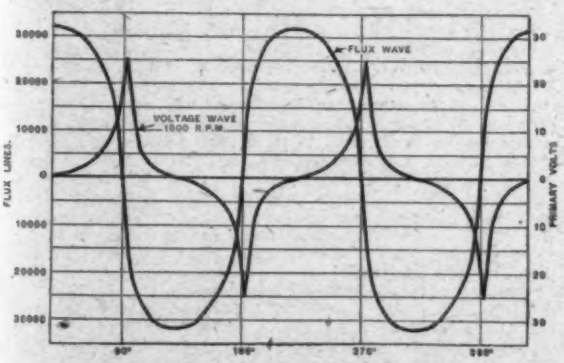
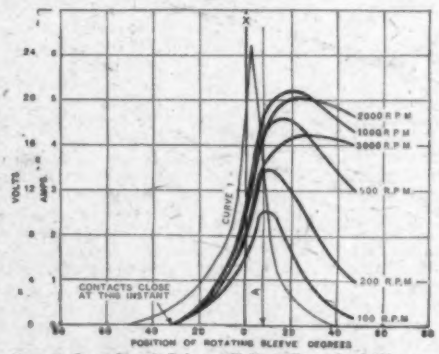


Fig. 6.—Flux and Voltage Waves, A 8 S Magnetos.



Curve 1, Open-Circuit Primary Voltage Curve for 1,000 r.p.m.
O X represents Axis of Fixed Armature position of Break.
A, for full advance.

Fig. 8.—Primary Current Curves.

* Abstract of paper read by Mr. A. P. Young, A.M.I.E.E., before the Aeronautical Society.

movable platinum contact screw is secured. A very strong steel spring fixed at one end to the contact lever arm, and at the other end to the base plate, serves to force the movable contact tightly against the adjustable fixed contact when the cam is not in engagement with the fibre heel.

It is clear that the contacts are opened eight times during each revolution of the cam shaft, which rotates at half the speed of the sleeve inductor, thus giving four breaks per revolution of the latter—as desired.

It is evident from the illustrations in the paper that the manufacture of such a magneto on a large scale must have been attended with considerable difficulties, because there are no fewer than 397 parts of different design, and a total of 860 parts are actually used in the construction of one machine. Bearing all this in mind, it is

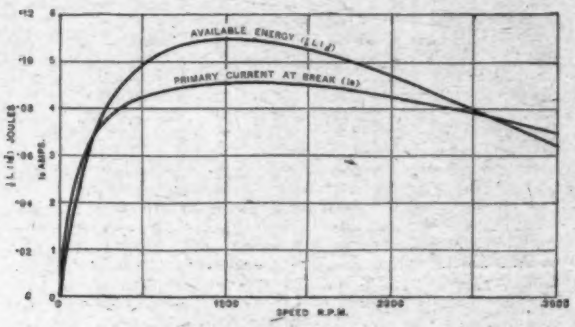


FIG. 9.

very gratifying to know that magnetos of this type are being produced in very large quantities under the guidance of Mr. R. Dumas.

Fig. 5 gives diagrams corresponding to different sleeve positions 45° apart, and on each diagram, the approximate flux distribution between the magnet poles is shown. Considering positions 1 and 3 (equivalent also to 5 and 7), it will be noted that in each case the flux through the armature core is zero. Furthermore, for the intermediate forms 2 and 4 (also 6 and 8), the direction of the flux through the core is alternately positive and negative; that is, in position 2 the flux flows upwards, and in position 4 downwards. In other words, the flux through the armature core reverses its direction *four* times during each revolution of the sleeve, giving four sparks per revolution. A magneto of this type is sometimes

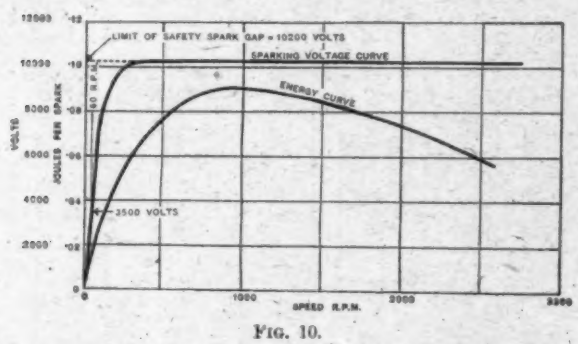


FIG. 10.

called a two-cycle machine. The flux wave, plotted in fig. 6, crosses the zero line at four points 90° apart, which correspond to the sleeve positions 1, 3, 5 and 7.

The maximum value reached by the flux wave is approximately 32,000 lines. This is the actual flux which links itself with the primary and secondary windings carried by the fixed armature core. Assuming a leakage coefficient of 1·4, the magnet flux works out at 45,000 lines.

The flux density in the magnets = 5,900 lines per sq. cm., and in the armature core 8,500 lines.

These figures are very high for an inductor type of magneto, although they are lower than the figures worked to in a magneto with rotating armature. The difference is accounted for by the fact that in the type "A" magneto—as in all inductor-type machines—there are four air-gaps in that portion of the magnetic circuit lying between the pole faces, as compared with only two gaps in the two-spark rotating-armature type of magneto. The increased reluctance due to the larger number of air-gaps naturally means that the available flux is smaller, using magnets of corresponding size and strength.

Having determined the flux wave, it is easy to compute the induced voltage wave resulting from the rotation of the sleeve, assuming that the contact-breaker is inoperative and the primary short-circuited; or the flux wave can be calculated from the voltage wave, as in fig. 6, in which the voltage wave is reproduced from an oscillogram at 1,000 R.P.M.

In the secondary coil a voltage is induced by the rotation of the sleeve, which conforms in shape to the primary voltage wave, but the maximum voltage is higher in the ratio of the windings, which in this magneto is very high, the maximum secondary voltage being about 3,000 volts at very high speeds. The maximum value is reached just after the sleeve has passed position 1, fig. 5, which the author calls the "dead centre," the phase displacement being 3°.

The author has plotted the primary current curves for six speeds, ranging between 100 and 3,000 R.P.M., on the basis of the open-circuit primary voltage, fig. 6, and the primary self-induction curve, fig. 7.

These curves, fig. 8, show that the maximum value of the primary current increases with the speed, very rapidly at low speeds, but hardly at all when the speed is high. In fact, at abnormally high speeds the maximum value will actually fall off, owing to the damping caused by the eddy currents induced in the

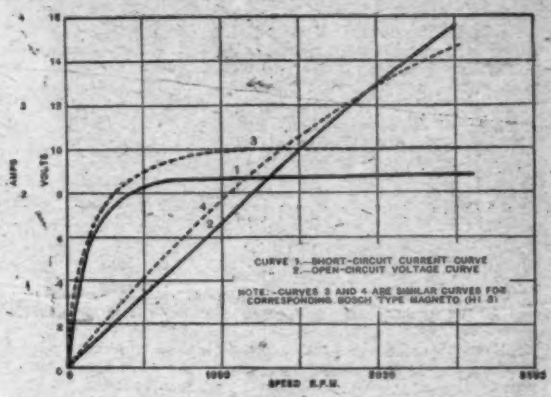

AMPS
VOLTS
CURVE 1.—SHORT-CIRCUIT CURRENT CURVE
2.—OPEN-CIRCUIT VOLTAGE CURVE
NOTE.—CURVES 3 AND 4 ARE SIMILAR CURVES FOR CORRESPONDING BOSCH TYPE MAGNETO (HI 3)
SPEED R.P.M.

FIG. 11.

rotating iron segments, which have the effect of preventing the flux in the stationary armature core rising to its proper maximum value after each reversal. It is important to note also that the maximum point on the current curve is, as it were, displaced forward in the direction of motion as the speed is increased.

The difference between the curves corresponding to the fully advanced position of the timing lever (fig. 8), and to the fully retarded position respectively at any particular speed is very small. For full advance the position of the rotating sleeve at "break" is shown on fig. 8 by the dotted line A, and by determining where this line intersects the six curves, the maximum current I_b for each speed can be found. For the fully retarded position of the timing lever, the contacts close at 17° instead of 32°, and the "break" is at

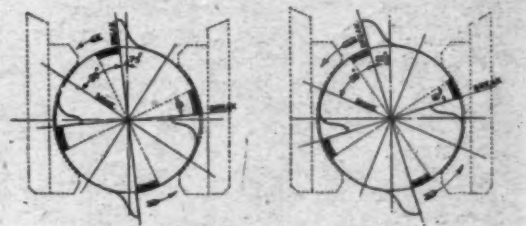


FIG. 12.

TIMING LEVER, FULLY ADVANCED. TIMING LEVER, FULLY RETARDED.

22½° instead of 7½°. The maximum voltage is proportional to I_b, and by plotting the latter against the speed, a curve representing the variation of voltage with speed is obtained (fig. 9); the upper curve represents the variation in the maximum available energy with the speed ($\frac{1}{2} L I_b^2$).

Maximum sparking voltage and spark energy curves obtained by experiment are plotted in fig. 10.

Experiment has shown that under normal working conditions a new sparking plug requires about 3,500 volts to cause a spark to jump between the electrodes when the piston is in the firing position and the compression is about 80 lb. per sq. in. It is therefore interesting to note that this voltage is given by the magneto at the very low speed of 60 R.P.M., the point being indicated on the curve. The normal running speed is 1,800 R.P.M. The energy output per spark was determined by a calorimetric method, and was about 80 per cent. of the calculated value (fig. 9), the remainder being dissipated in the iron masses in the magnetic circuit and in the windings. Oscillograms reproduced in the paper show that the actual value of I_b agrees substantially with the calculated value in every case.

On determining the value of the armature core flux, it is found to diminish gradually as the speed is increased, due to eddy currents set up in the masses of iron, which cause the energy curve to drop at about 1,000 R.P.M.; this effect can be reduced more readily in the polar inductor type of magneto by careful attention to the design. The rotating-armature type of magneto standardised by Bosch is a very bad offender from this standpoint; in one of the Bosch Co.'s latest magnetos, at 4,000 R.P.M., the flux fell off 23 per cent.

In fig. 11, curve 2 shows the relationship between the R.M.S. value of the open-circuit primary voltage, and curve 1 the short-circuit

primary current, with the speed. The shape of the voltage curve, which would otherwise be a straight line, shows that the armature core flux falls off as the speed increases. The dotted curves 3 and 4 relate to a Bosch magneto of corresponding type. A very good idea of the probable operation characteristics of a magneto can be gathered from the value of the open-circuit primary voltage at a definite speed; the B.T.H. Co. measure the voltage of every magneto at 2,000 R.P.M. immediately after magnetising, with and without the secondary short-circuited, and the values must not fall below a fixed

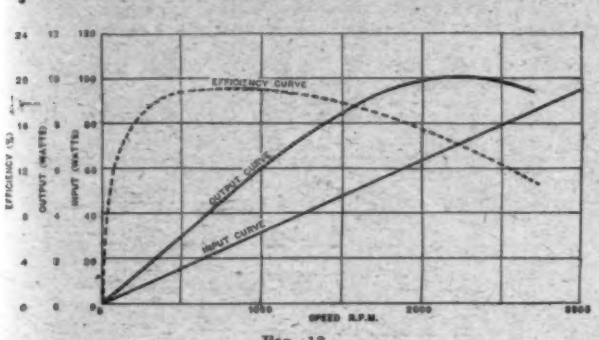


FIG. 13.

minimum in the latter case, or drop more than a certain percentage in the former. A large percentage drop indicates that the magnets have low coercive force.

Fig. 12 shows some oscillograms which have been plotted in the form of circle diagrams, the duration of the H.T. spark being indicated; the diagram enables one to form a mental picture of the growth of the currents induced in the primary and secondary during one revolution of the sleeve inductor.

Fig. 13 gives curves showing the variation of driving power, and output, in watts, and the efficiency, with the speed.

(To be continued.)

REVIEWS.

Advanced Text-book of Magnetism and Electricity. By R. W. Hutchinson, M.Sc., A.M.I.E.E. London: University Tutorial Press. In two volumes. Price 8s. 6d. complete.

The issue of a comprehensive advanced manual of magnetism and electricity from the pen of the joint author of Davidge & Hutchinson's "Technical Electricity" is an event of some interest to the student of physics. It is, perhaps, unfortunate that the publication should occur when the number of such students is so seriously depleted by the claims of war-work at home and abroad. The fact that Mr. Hutchinson's book is to be regarded as a kind of lineal successor to Dr. Wallace Stewart's "Higher Text-book of Electricity and Magnetism" also raises our expectations with regard to it.

In his preface the author states that the aim of the book is to give "a clear and comprehensive account of the main principles of the subject based on accurate scientific definitions and embodying the distinctive results of modern research." Both the experimental and theoretical sides of the work have been fully treated, and great care has been taken to deal adequately with the many difficulties which, in the present state of our knowledge, must necessarily arise in connection with the theoretical explanations of the various phenomena. The scope of the book is that of the final degree examinations of the universities, and consequently a knowledge of the subsidiary mathematics up to and including the notation and first principles of the calculus has been assumed throughout. Although intended for advanced students some of the elementary sections are treated at length, and there is no doubt that, as the author anticipates, the student who feels that he already has a sound knowledge of these fundamental principles will appreciate a revision on scientific lines.

The first volume deals with magnetism and electrostatics. Some of the earlier sections in both of these subjects are reminiscent of Stewart's "Higher Text-book," but even these elementary and fundamental matters have been brought thoroughly up to date and reference has been made to recent research.

The first two chapters in both subjects are entitled "Fundamental Phenomena" and "Fundamental Theory." The former gives an introductory survey of the whole subject from an experimental point of view, and the latter deals with the mathematical basis on which subsequent chapters depend. There is very little that we have been accustomed to regard as inseparably connected with Sir J. J. Thomson's "Mathematical Theory" that Mr. Hutchinson has not covered, and in many cases he has extended the usual mathematical investigations to special cases, and given proofs and definitions which will be appreciated by students for their neatness and brevity. A few notable examples of this perspicuity of diction combined with scientific accuracy of definition may be mentioned. Section 88, on field strength, unit field, tubes of force, and induction, deals with the intricacies of Maxwell tubes, tubes of induction, and Faraday tubes in a very masterly manner; forces between small magnets and magnetic shells are also well done, and the development of the idea of potential in both magnetism and electrostatics leaves nothing to be desired.

Chapter III, on magnetism, deals with magnetic measurements. All the usual magnetometric methods are given, but it is remarkable that the measurement of magnetic fields by search coils, bismuth coils, and the methods due to Du Bois and Lippman are not even mentioned, the only methods of measuring field strengths given being those of the deflection and oscillation magnetometers.

The remaining chapter on magnetism, that on terrestrial magnetism, is a very complete treatment of the subject. The dip circle is usually dealt with at length in such manuals, but it is seldom that the Kew magnetometer receives a fair share of attention. Here, however, the methods of determining all the magnetic elements are very carefully described and illustrated, and some account is also given of magnetographs and the question of variations in these elements. An interesting paragraph outlines the various theories of terrestrial magnetism and the present-day attitude towards them.

In addition to the chapters already indicated, the electrostatics section includes important chapters on condensers and capacity, instruments (from the historic Coulomb balance to the most recent forms of electrometer), measurements (including the important experiments of Silow, Aron and Cohn, and Boltzman and Hopkinson on specific inductive capacity), and atmospheric electricity.

The second volume deals with electro-dynamics. The earlier chapters on cells and the properties of currents are thorough expositions written along the usual lines. The author is particularly clear and exact in his statements concerning units—a subject in which a little knowledge is a very dangerous thing—and he deals very fully with the more recent theories and experiments concerning the chemical effects of the current, even concentration cells and the Lippman electrometer receiving a fair share of attention. The chapter on thermo-electricity is one of the best in the book, and incidentally reveals by its methods and nomenclature the author's *alma mater*!

A separate chapter is devoted to electrical measurements, and a further chapter to the measurement of inductance. The concluding paragraph of the latter is worth quoting, because it tells us at once that Dr. Hutchinson is *not* one of those teachers who forget that they were once students:—

"The student who works through the preceding tests will come to the conclusion either that he is a poor experimenter, or that the apparatus is wrong—probably the latter. Both conclusions may possibly be correct, but the methods are nevertheless troublesome and unsatisfactory at the best. Newer methods, depending on the employment of alternating currents, are being developed." He then mentions briefly the methods depending on Campbell's vibration galvanometer.

It is, of course, expected of such a text-book as this that it will not only deal with the principles and practice of magnetism and electricity as they were understood by our fathers, but that it will also give introductions to those great outlying tracts of knowledge which are now of such gigantic importance as to merit whole literatures of their own. Such are alternating currents, electrical oscillations and waves, the passage of electricity through gases, and radio-activity and the electronic theory.

It is to these subjects that Mr. Hutchinson devotes the last 180 pages of his second volume. He gives brief historical accounts of each subject, discusses the principles, and describes the chief experiments, and refers to the directions along which controversy and research are proceeding. The whole of this part of the book appears to us to be above criticism, and no student will regret the source of his first instruction in these matters if he reads from this book. The author would be the last to claim any finality for the views expressed in these chapters, and the student may be warned against dogmatism in approaching these borderlands of physical knowledge. Mr. Hutchinson has given a fair statement of the condition of electrical theory as it is to-day—to-morrow will have theories of its own.

Every chapter in the book has a series of exercises at the end, many of which are taken from university examination papers, including the honours papers. There is also an appendix of useful tables, and a brief bibliography. Both volumes have some striking features, and, what is of far greater importance, they lack no essential of a sound and useful text-book. The two parts are not sold separately, but the price charged for the complete work is extremely moderate.—P. H. S. K.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

FRANCE, ALGERIA, AND TUNIS.—The Ministerial Decree of April 13th restricting the importation into France and Algeria of goods from foreign countries has been modified by further Decrees, dated July 8th and 13th, the effect of which is to make it necessary for French importers to obtain a special licence from the "Comité des dérogations aux prohibitions d'entrée" of the Ministry of Commerce, for merchandise other than that specified (food products, manures, fuel, agricultural machinery, &c.) which was not actually shipped prior to July 9th.

Under a Presidential Decree of June 15th fees are now being charged for both import and export licences in France. For imports other than by parcel post and for imports by parcel post, consisting of 10 parcels or more, the fee is 5 francs per licence; for less than 10 parcels by parcel post, the fee is 50 centimes per parcel. Similarly, in the case of export licences the fees are 2 francs per licence and 20 centimes per parcel, respectively.

Fees at the same rates are being charged in Tunis as from July 1st.

TRANSIT OF GOODS THROUGH FRANCE TO SWITZERLAND, ITALY, AND SPAIN.—It has been officially announced that the transit arrangements for goods sent *viâ* France to Italy and Spain have now been made similar to those in force for goods going to Switzerland. Goods which are not prohibited to be exported from the United Kingdom to Italy and Spain, but which are prohibited to be exported from France to those destinations, can now be sent under the "pink certificate" S. 45 B, which will satisfy the French Customs authorities, and will ensure that the goods shall not be detained by them. The certificates are handed to the master of the ship conveying the goods to France, with a notice stating that they must be delivered to the Customs authority at the port of discharge, and that failure to do so may lead to the detention of the goods.

Applications for licences in respect of such consignments should be addressed to the War Trade Department, and special attention should be drawn to the fact that the goods figure on the French list of prohibited exports, and that it is proposed to ship the consignment to Italy or Spain *viâ* France, and not direct by sea. In the case of Spain, however, the arrangement will not apply to consignments of goods which exceed half a ton in weight.

A full statement of the regulations now in force respecting the transit through France of goods sent from the United Kingdom to Switzerland, Italy, and Spain, *viâ* France, is published in the official *Board of Trade Journal*. Firms interested should consult the *Journal*, or they can obtain full information from the Department of Commercial Intelligence, 73, Basinghall Street, E.C. 2.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

13,282. "Sparking plugs." E. T. Cottingham & F. W. A. Smith. September 17th.
13,286. "Electric furnaces." H. Etchells, H. A. Greaves, and T. H. Watson & Co. September 17th.
13,311. "Armatures for dynamo-electric machines." British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.). September 17th.
13,318. "Electric ignition apparatus for internal-combustion engines." G. E. Turnbull. September 17th.
13,328. "Electric furnaces and apparatus for regulating variations of current and distribution of heat in a furnace, and in refining steel, &c." E. C. R. Marks (Soc. Anon. Italiana G. Ansaldo & Co.). September 17th.
13,331. "Holders for electric incandescent lamps." C. Wirt. September 17th.
13,332. "Mechanism for limiting movement in electro-mechanical cranes, drawbridges, dam gates, &c." Allmanna Svenska Elektriska Aktiebolaget and E. H. Lindblom. September 17th.
13,344. "Means for securing shade covering to electric filament lamp." A. Schofield. September 18th.
13,353. "Magnetic seaplane torpedo." W. J. Rhodes. September 18th.
13,358. "Electric tramway trolley wire finder and trolley wheel adjuster." D. A. Halpin & R. Lancaster. September 18th.
13,369. "Sparking plugs for combustion or explosion motors." G. A. Pariani. September 18th.
13,378. "Sparking plugs for internal-combustion engines." E. Allen, Automatic Telephone Manufacturing Co., F. W. Mayes & A. C. Spenser. September 18th.
13,386. "Distributors for high-tension ignition systems." G. S. Holland. September 18th.
13,392. "Telephone systems." Automatic Electric Co, U.S.A. September 18th.
13,399. "Electrical and mechanical apparatus for direct-current motors." G. Paratore. September 18th. (Italy, October 9th, 1916.)
13,406. "Manufacture of composite bimetallic articles." British Thomson-Houston Co. (General Electric Co., U.S.A.). September 18th.
13,407. "Liquid rheostats." Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.). September 18th.
13,420. "Accumulator electrode grids." Apex Electric Accumulator Syndicate & S. Willner. September 18th.
13,425. "Speed-controlled electrically-operated machines." H. H. Jeffcott. September 19th.
13,441. "Apparatus for electrolysis of water." K. Kimura. September 19th.
13,451. "Sparking plugs, &c." T. Crosbee & Sons and H. R. Wilks. September 19th.
13,462. "Electric arc carbons." W. Thompson. September 19th.
13,463. "Aerial illumination." W. Thompson. September 19th.
13,469. "Manufacturing electric incandescent lamps, &c." British Thomson-Houston Co. (General Electric Co., U.S.A.). September 19th.
13,473. "Rectification of alternating currents of electricity." S. A. Pollock. September 19th.
13,474. "Electric water heaters." W. J. Sims. September 19th.
13,475. "Electric thermostat." W. J. Sims. September 19th.
13,476. "Electric changing switch." W. J. Sims. September 19th.
13,520. "Electric flash lamps." C. R. Hall. September 20th.
13,527. "Armature without commutator for direct-current machines and single-phase motors." O. Liggtti. September 20th.
13,536. "Magnetic induction wire." C. H. Blyton. September 20th.
13,541. "Telephone exchange systems." Western Telegraph Co. September 20th. (U.S.A., September 22nd, 1916.)
13,542 & 13,543. "Means for supporting electrodes in ionic tubes for use in wireless telegraphy, &c." O. Durdle & Osram-Robertson Lamp Works. September 20th.
13,544. "Electric furnaces." British Thomson-Houston Co. (General Electric Co., U.S.A.). September 20th.
13,547. "Electroplating apparatus." G. T. Pothoff. September 20th.
13,551. "Trolley wire systems for electric railways, tramways, &c." P. Dawson & F. W. Fawdry. September 20th.
13,566. "Tilting adjustment gear for electric furnaces." J. H. Twidell. September 21st.
13,615. "Electric switches." C. G. Bennett & H. Garde. September 21st.
13,616. "Electromagnetic lockout switch." R. P. Bosson and A. West and Co. September 21st.
13,627. "Security or locking devices for electric incandescent lamps." Benjamin Electric, Ltd., & E. Fowler. September 21st.
13,631. "Electrical distributors." F. L. Hollister. September 21st.
13,633. "Keyed interrupter or cut-out for electrical installations or appliances on motor cars, &c." C. F. T. Claxton & E. J. Claxton. September 21st.
13,677. "Ampere-hour meters." British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.).
13,681. "Detective and protective devices for electric cables." C. J. Beaver, E. A. Claremont & A. F. W. Richards. September 22nd.

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

7,444. Engine-starting Systems. C. F. Kettering & W. A. Chryst. May 25th, 1915. (100,541.)
12,044. Electrical Fuses and Parts appertaining thereto. A. Crawford and W. Preston. August 25th, 1916. (109,072.)
12,045. Electrical Fuse Boards or Systems. A. Crawford & W. Preston. August 25th, 1916. (109,073.)
12,074. Distance and Speed Indicators for Ships. K. T. F. Jung. August 25th, 1915. (101,297.)
12,229. Illuminating Apparatus. W. J. Davis. January 3rd. (103,106.)
12,231. Induction Electric Motors. G. Pestarini. August 29th, 1916. (109,087.)
12,236. Propulsion of Ships and similar Vessels. H. de M. Snell. August 29th, 1916. (109,089.)
12,267. Coal and like Cutting Machines. F. E. Van Slyke. August 30th, 1916. (109,092.)
12,316. Trolley Poles for Electric Cars and the like. T. Warsop. August 31st, 1916. (109,098.)
12,350. Systems of Electric Motor Control. British Thomson-Houston Co., H. C. Hastings & H. F. Farmer. August 31st, 1916. (109,101.)
13,710. Aerials for use in Wireless Telegraph or Telephone Systems. C. D. J. Dunning. September 7th, 1916. (109,111.)
13,142. Electric Battery Cells. C. Kelway-Bamber. September 15th, 1916. (109,122.)
14,041. Windings of Electric Inductance Coils and other apparatus. British Thomson-Houston Co. (General Electric Co., U.S.A.). October 3rd, 1916. (109,129.)
14,843. Range Finders. Metropolitan Carriage, Wagon & Finance Co., W. G. Wilson & W. A. Tritton. October 19th, 1916. (109,138.)
15,337. Electric Joint-making Washers. C. J. Beaver & E. A. Claremont. October 27th, 1916. (Addition to 10,023/16.) (109,142.)
16,518. Interrupters for Ignition Dynamos. C. T. Mason. June 19th, 1915. (Divided application on 8,584/16.) (102,268.)
18,506. Electric Incandescent Arc Devices. British Thomson-Houston Co. (General Electric Co., U.S.A.). December 27th, 1916. (Cognate application on 18,507/16.) (109,188.)

1917.

177. Contact Maker and Interrupter for Electric Ignition Systems. W. J. Mellersh-Jackson (Phillips-Brinton Co.). January 4th, 1917. (100,193.)
4,573. Apparatus for Starting Engines, more particularly Heat Engines. Akt. Brown, Boveri et Cie. April 18th, 1916. (105,910.)
7,636. Apparatus for Protecting Electric Installations. G. Giles. May 27th, 1916. (109,237.)
9,571. Winding or Hauling Machinery. Siemens Schuckertwerke Ges. June 16th, 1916. (Addition to 101,407.) (107,706.)

Packing Glassware.—American cut glass, especially the cut glass with silver trimmings, is winning an enviable place in the Peruvian market. Shipments of plate glass are liable to have dropped upon them at any time a ton or two of other goods; the Belgian manufacturers have demonstrated that glass can be packed to meet this condition. The only thing to do is carefully to pack the product tightly in a light case, which must be enclosed for export in an outside case of strong lumber, made large enough so that an ample cushion can be provided on all sides of the inside case that contains the glass. This cushion will receive the shock of blows, and distribute the impact.

Instead of having the ends and sides of the inside case parallel to the outer one, it is preferable that it should lie diagonally, so that two opposite corners may touch the outside case, and two other opposite corners have an ample cushion. In this manner, it is said, glass can be packed for export to any point along the coast, without the least danger of breakage.—*Scientific American.*